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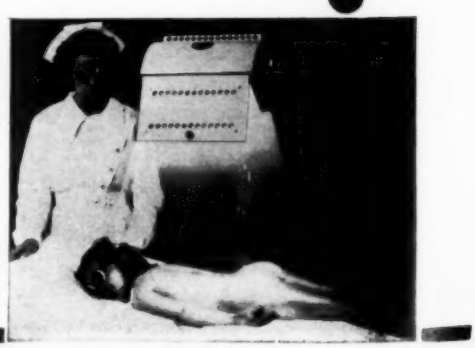

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OBSERVATIONS ON SHORT WAVE HEAT *

A. BACHEM, Ph.D.

Department of Physiology, University of Illinois College of Medicine

CHICAGO

Although a great many studies of the field distribution of, and the resulting heat production by, short wave radiation have been made, these problems are not yet fully solved. Therefore, a series of investigations was carried out, which was started with simple in vitro experiments, followed by others under complicated conditions in the living animal.

The first of these studies has already been reported.[1] Therein various biologic materials were exposed to short waves under strictly identical conditions as to volume, shape, position in the field, wavelength, intensity and time. In spite of the identity of exposure the various materials exhibited great differences of heating. For a 5 m wave, e. g., the relative heating was in a descending order for fat, bone marrow, bone, lung, skin, spleen, liver, hair, brain, muscle. Blood corpuscles were heated more, blood serum less than whole blood. The results were different for other wavelengths to such a degree that the order of the previously named biological materials was altered. This indicates that an optional wavelength exists for strong heating of one substance, while the other materials are kept at relatively low temperatures.

These results suggest that comparatively short waves are optional for the heating of regions which contain fat and bones and for the prevention of overheating of the skin. Other wavelengths may be preferable for the selective heating of muscle, liver, spleen and other organs.

While in these fundamental studies on selective heat production in biologic tissues the field distribution was purposely left out of consideration, this factor is of such importance for the actual heat production in vivo, that it necessitated a detailed study. The first studies were performed by use of coils, which set up induction currents, but this method did not give dependable and accurate results. Better results were obtained by the luminescence of small neon tubes in the field. Gale and Edelman[2] have used this method for the determination of the direction of the lines of force. In this study the method was adapted to a direct measurement of the electromagnetic forces throughout the entire field. Either several standardized neon tubes of different sensitivity were moved through the field and produced at constant milliamperage, or one neon tube was placed in different parts of the field, while the milliamperage was varied. In both cases the threshold of luminescence served to indicate a certain gradient of the electromagnetic force; and the energy distribution of the field could be evaluated (in areas of similar divergency of the lines of force).

Direct results as to the heat production in the field were obtained by placing small quartz benzol thermometers in the field. Such a thermometer could be made extremely sensitive by surrounding its bulb with a thin glass capsule containing saline solution. The concentration of this solution was adapted to the length of the short waves, so as to respond to selective heating.

Experimental Results

The results of all these experiments prove that the field distribution between equal parallel condenser plates can be represented by a saddle surface. In every plane perpendicular to the plates the intensity decreases from the plates toward

* Read by title at the Eighteenth Annual Session of the American Congress of Physical Therapy, New York City, September 8, 1939.

the center of the field, and in all planes parallel to the plates the intensity increases toward the center. This increase is rather gradual in the area between the plates, and rapid at the border of that area. There exists an appreciable intensity on the outside of the condenser plates, which falls to very low values, however, at comparatively short distances. The quantitative distribution depends strongly on the size of the condenser plates and their relative distance. The greatest intensities inside and least outside are found for large condenser plates at short distances. If small plates are kept at a great distance, however, the intensity and its distribution inside and outside of the field become rather similar.

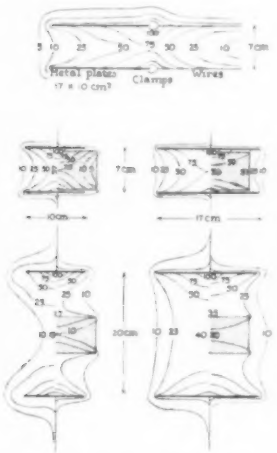

Fig. 1. — Short wave (6 m.) field distribution of energy, graphically represented by isotherms showing percentage of maximal heating. The upper figure and the left half of the other figures refer to air as dielectricum, the right halves refer to a field distorted by ground meat, 13x 13x6 cm.³

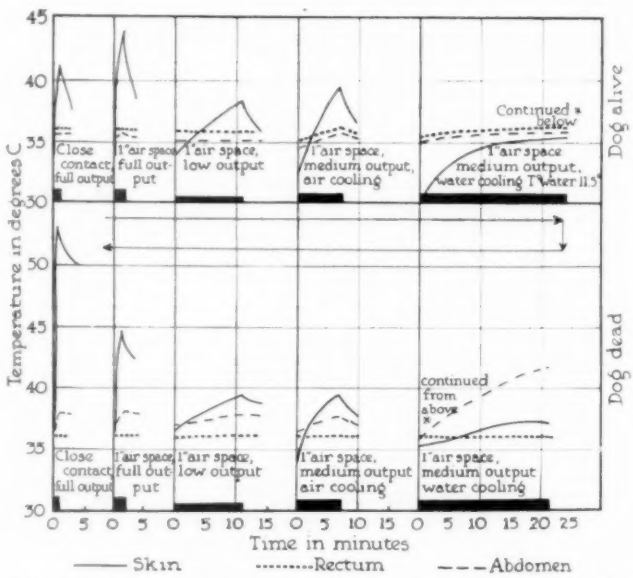

Fig. 2. — Effects of short waves ($\lambda = 5$ m) on the subdermal, abdominal and rectal temperatures of the dog (11 lbs., 5½ inches abdominal diameter) under various conditions. (Room temperature 26.5° C.).

Figure 1 demonstrates these facts for air as a dielectric (upper picture and left sides of the four others), and also for a block of ground meat inserted into the field (right sides of lower pictures). The upper picture represents a rather asymmetrical field distribution, due to the asymmetrical connection of the wires, and it also demonstrates the disturbing influence of clamps. The four lower drawings refer to symmetrical wiring of square (or circular) plates, and only one-half of the field is shown, which is entirely symmetrical under these circumstances. The value of air spacing and of large condenser plates for deep heating is demonstrated by the meat experiments. The actual figures refer to a wavelength of 6 meters. A replacement of this wavelength by one of 12 meters leaves the field distribution in air practically unchanged, but it lowers the percentage depth dose in the meat block considerably.

In animal experimentation and under clinical conditions the heat production is determined by both the field distribution and the selective heating of the various materials. Of course, heat conduction and heat convection distribute the generated heat rapidly throughout the tissues. This is particularly true for the convection produced by the blood circulation.

In order to determine the role played by these various factors, experiments were conducted on live animals and continued after the animals had been killed.

One set of experiments was conducted on a dog, (anesthetized by nembutal) as described and illustrated in figure 2.

The short wave field ($2\lambda = 5$ m, electrodes 3 inches by 5.5 inches) was applied laterally to the abdomen. Two quartz benzol thermometers were placed beneath the right and left abdominal skin near the center of the electrodes and the averages of their readings were recorded (skin). Two thermometers were inserted in the median line between the intestines near the center of the field and the average was taken (abdomen). One thermometer was introduced into the rectum, which was well outside of the short wave field (rectum).

In the first experiment short waves were applied for one minute at the highest output of the apparatus with the condenser plates in immediate contact with the skin. With this arrangement the skin heated up considerably during the application time, but cooled off rapidly after the current was turned off. The temperatures of the interior and the rectum remained practically unaltered. The last experiment (reported vertically below the first one) was conducted under the same conditions some time after the animal had been killed. Here the skin heats up considerably more and cools off less rapidly. The interior temperature also rose noticeably during the application and fell afterward. (The rectal temperature is of no significance in the dead animal). This experiment illustrates the relative roles of the heat production in the short wave field and the heat dissipation by the circulating blood. The heat loss by conduction alone (noticeable in the experiment on the dead animal) is practically negligible since it is of a lesser order of magnitude than the heat production.

In the second experiment an air space of one inch was left on both sides between the electrodes and the skin. The treatment time was prolonged in order to secure a similar heating effect on the skin. It is noticeable that under these conditions the relative deep heating is improved, although the actual heating of the center parts of the abdomen was still small: 0.5 degree in the live animal, 1 degree in the dead one.

In the following experiment the output was lowered and the exposure time was much increased. In the live animal the cooling effect of the circulation completely neutralized the heating effect inside of the abdomen. The skin temperature increased very slowly and fell even more rapidly after the termination of the exposure. In the dead animal the skin and abdominal temperatures increased markedly.

(In all the experiments on the dead animal it was found impossible to prevent the central temperature from rising higher than the skin temperature, for while the interior cooled only by the mechanism of heat conduction, the skin cooled both by convection and radiation through the air. Therefore, in these experiments the temperature increase is of greater significance than the absolute temperature figures.)

Experiments Under Cooling Conditions

In the next experiment the skin was cooled by a stream of cold air through the perforated hard rubber plates of the electrodes, while the short waves were applied at medium output for medium exposure time. This cooling effect was rather insignificant, particularly in the live animal.

A last experiment was conducted by use of a water cooling device, which allowed cold water to circulate through a flat glass container between the electrodes and the skin. With this method the skin temperature could be decreased before the short waves were applied, and the interior and rectal temperature could be raised to higher temperatures than the skin temperature.

After 24 minutes the animal was killed and the experiment continued without interruption or alteration. The interior temperature now increased considerably, while the skin temperature fell and the rectal temperature remained constant.

By this method (water cooling) deep heat application is possible without heating and even with cooling of the skin. This method may prove to be valuable

for animal experimentation. Whether it is applicable to therapy in man must be decided by careful clinical experimentation.

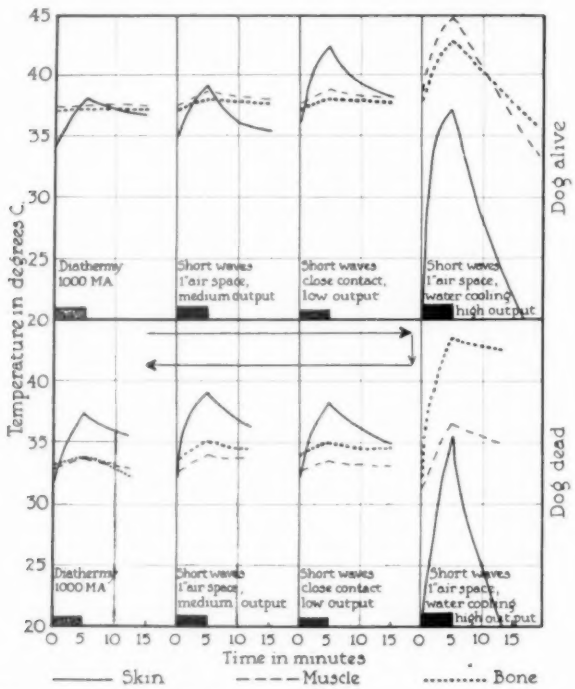

Fig. 3. — Effects of diathermy and short waves ($\lambda = 5$ m) on the temperatures of skin, muscle, and bone of dog's leg 1 to 3 inches diameter (electrodes 3 by 5 and ½ inches) at various conditions. (Room temperature 27° C.).

Figure 3 illustrates corresponding experiments conducted on the leg of a dog. The bone was located more centrally than the muscle and therefore heated less. As soon as water cooling was applied, the bone was heated considerably more and it retained its higher temperature throughout the rest of the experiment. In this experiment also, the maximal temperature as well as the temperature rise was greater for the skin than for the internal structures, except when water cooling was used. A comparison of diathermy currents with short waves showed no decided differences, as long as the latter were applied by direct contact with the skin. The advantage of short waves over diathermy manifests itself when use is made of air spacing and artificial cooling of the skin.

In these experiments the deep heating effect in vivo of locally applied short waves was not as great as that reported by several other authors.[3, 4, 5] This comparatively small effect is explainable on more than merely the basis of the physical facts (field distribution, heat conduction and convection). One must also assume that physiologic reflexes play a prominent role in the prevention of excessive local heating. Since a comparatively small increase of temperature causes vasodilatation in the affected region, the additional heat loss resulting from increased convection will tend to keep the temperature down. In order to demonstrate this effect and to judge its importance concerning heat regulation as well as therapeutic effects, plethysmographic experiments were conducted on the kidney, spleen, and an intestinal loop. The organ was lifted outside the body cavity and was enclosed in an especially designed hard rubber or bakelite oncometer. The apparatus was filled with physiologic saline solution which contained a small mercury thermometer. Volume changes were recorded by the use

of tambour and kymograph. The apparatus was calibrated by injection of 1 cc. water at the close of the experiment.

Figure 4 demonstrates the effect of a one minute application of short waves to the kidney. After a latency of several seconds the volume increases sharply, to level off after an increase of 15 to 20 per cent, depending upon the intensity of the short waves and the temperature increase. (The temperature figures of the chart refer to the saline solution surrounding the kidney, and differ considerably from the average temperature of the kidney. A comparative measurement of the temperature changes in the center of the kidney of another dog and in the surrounding solution gave a ratio of 1 to 6, indicating that the actual average temperature rise in the kidney of the experimental animal amounted to about ½ degree C.). At the close of the application the volume decreases after a short latency, first rapidly, then more gradually, with an indication of wave-like changes. The outstanding facts of this experiment are the rapidity and the magnitude of the volume changes, in contrast to the very gradual and insignificant change in the control experiment with the kidney vessels clamped.

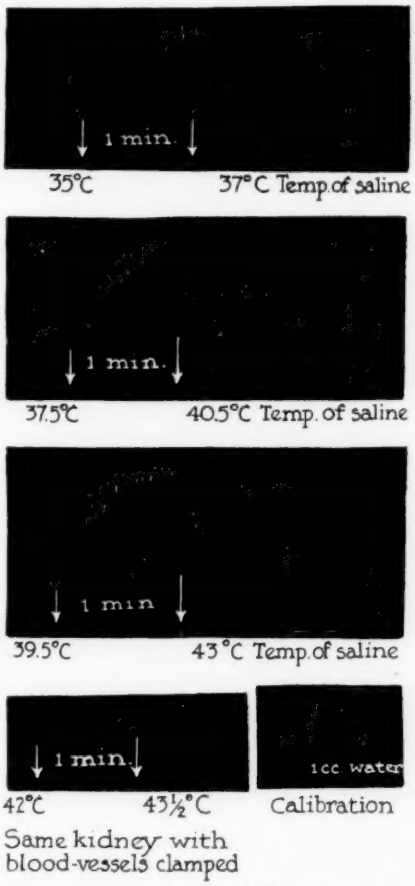

Fig. 4. — Volume changes of kidney (30 cc.) of dog (37 lbs.) exposed to short waves (6 m). (Bakelite oncometer, filled with saline.)

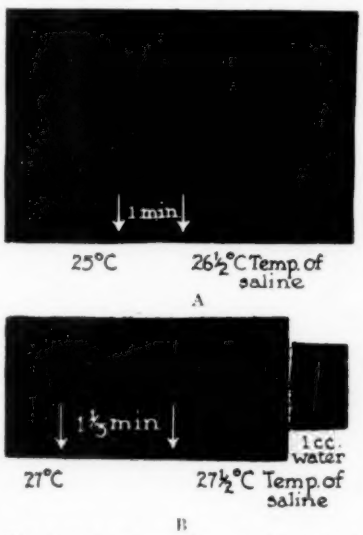

Fig. 5. — *A*, volume changes of intestinal loop (155 cc) of dog (37 lbs.) exposed for short waves (6 m). (Hard rubber oncometer filled with saline.) *B*, same intestines in metal oncometer heated by Bunsen burner.

Figure 5 represents the rapid, pronounced volume changes of an intestinal loop exposed to short waves, in contrast to the slow, small changes caused by heating with a Bunsen burner. The difference between the two results is due mainly to the volume heating by short waves and the surface heating by the other method. (An exact comparison at identical temperatures was prevented by technical difficulties.)

The last figure shows the short wave reaction of the spleen, represented by longer latency and irregular wave-like volume changes. These reactions could be obtained only after comparatively long and strong short wave applications (fig. 6).

These experiments prove that an initial small temperature increase caused by short waves leads to a pronounced vasodilatation in the affected area, which by increased blood circulation and heat convection prevents the temperature from rising excessively.

Fig. 6. — Volume changes of spleen (90 cc.) of dog (37 lbs.) exposed to short waves (6 m.). (Hard rubber oncometer filled with saline.)

It seems probable that the increased tissue drainage caused indirectly by the short waves is responsible for more therapeutic effects than the rise of temperature as produced directly by these rays.

Summary *

Measurements of field distribution and heat production between and outside the condenser plates by use of several methods demonstrate a comparatively small relative depth dose.

The heat distribution in the animal depends upon three important factors: the energy distribution in the field; the selective heating of various biologic tissues; and the heat transport by convection and conduction. The relative importance of the heat convection through the circulating blood is shown by comparative experiments on animals before and after death. The equalizing power of the blood circulation is so pronounced that a marked deep effect can only be secured by overheating of the skin. Therefore, the possibility of artificial cooling of the skin is studied and discussed. Even with a comparatively small rise of temperature the vasodilatation and increased circulation in deep seated organs are pronounced and may be of therapeutic value.

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* The author wishes to take this opportunity for expressing his appreciation to the Adlanco X-ray Corporation and the E. J. Rose Company, for placing the short wave apparatus at his disposal.

TREATMENT OF GONORRHEA BY ARTIFICIAL FEVER ALONE AND IN COMBINATION WITH SULFANILAMIDE *

ELMER BELT, M.D.

and

ALVIN W. FOLKENBERG, M.D.

LOS ANGELES

In recent years the management of gonorrhea has twice been revolutionized by electropyretic and chemotherapeutic methods. Artificial fever therapy came into use first, and with it gonorrhea, whether acute or chronic, was given the chance of rapid cure. This method was found to be especially effective in such acute complications as arthritis and epididymitis, which heretofore were very difficult to manage. During the first few months of our use of fever therapy we frequently treated patients who had suffered from their disease for five, ten, fifteen and even twenty years. The majority of these we were able to cure in a single day.

Fever therapy, because of its cost and technical difficulties, was necessarily limited in its employment. With the advent of sulfanilamide and related compounds we have a method of treating gonorrhea which is available to the entire medical profession. Combined with artificial fever it has proved still more effective and today offers the optimum chance of cure in cases resistant to sulfanilamide and local therapy.

We wish to review our results in treating gonorrhea with artificial fever both before and after the advent of sulfanilamide. From July 8, 1936, to August 1, 1939, we have given 1,061 artificial fever treatments to 302 patients, 226 of whom had definitely proved gonococcic infections (table 1). Of these latter, 19 did not return for a sufficient number of follow-up examinations and hence are excluded. This leaves a total of 207 patients treated and adequately followed, upon whom this report is based.

TABLE 1. — *Analysis of Fever Treatments of Gonococcic Patients Given from July 8, 1936, to August 1, 1939.*

A total of 1,061 treatments given to 302 patients.

Total number of patients treated	226
Excluded because of inadequate follow-up	19
Total included in this report	207

These are grouped as follows:

Single fevers without Sulfanilamide	134 patients
Combined fever and Sulfanilamide	68 patients
Fevers equal to Thermal Death Time	5 patients
Total	207

The beginnings of our fever therapy department were inspired largely by the work of Stafford L. Warren and his colleagues at the University of Rochester Hospital, New York. In 1933, Carpenter, Boak, Mucci and Warren reported the in vitro thermal death time of 15 strains of N. gonorrhea.[1]

* Read at the Eighteenth Annual Session of the American Congress of Physical Therapy, New York City, September 7, 1939.

This was found to vary from 7 to 20 hours at 106.7 F. In a more recent work[2] the same authors have reported the thermal death time at 106.7 F. on 250 strains. This showed a variance from 6 to 34 hours with a mean of 16 hours. In 75 per cent of the strains the thermal death time ranged between 11 and 21 hours. These laboratory data furnish a convincing rationale for a long-sustained single session for the treatment of gonorrhea. Warren, after having determined the thermal death time of the patient's own strain of gonococcus, gave a single treatment of equal duration and intensity. By this method he reported a high percentage of cures.[3,4]

In the early part of our work we lacked facilities for determining the thermal death time of each patient's gonococcus. We therefore arbitrarily selected 10 hours at 106.7 F. as an optimum amount to be given at one session and used this as our routine procedure from July, 1936, until sulfanilamide came into use.

Preparatory Measures

Production of fever at this height and duration is not to be undertaken lightly. Each patient must be carefully studied before the therapy is attempted. A detailed history is taken. Because of their relation to liver damage, alcoholism and previous attacks of jaundice are carefully noted. The patient is subjected to a general physical examination, including a urinalysis and a blood Wassermann test. Smears and cultures must be positive for the gonococcus. The cardiovascular and respiratory systems are further investigated by a competent cardiologist. His studies include an electrocardiogram, fluoroscopy of the heart and chest, measurement of the vital capacity and an exercise and recovery test.

Several contraindications to the use of long high fever should be mentioned. Patients past forty years must be treated with great caution. Those with electrocardiographic evidence of myocardial damage or heart block do not tolerate fever well. Mild valvular lesions, if well compensated, do not of necessity preclude treatment. Chronic alcoholism and advanced cardiovascular renal disease cannot stand long-sustained treatment. Patients with acute respiratory infections, especially active pulmonary tuberculosis, should not be subjected to this treatment.

Two or three days of preparation are advisable before treatment. This consists of forcing fluids and the giving of a high caloric, high carbohydrate, low fat and high sodium chloride diet. Drugs which inhibit perspiration should not be given. The patient should report for treatment without breakfast. The temperature, pulse, respiration and blood pressure are taken, and 10 cc. of blood is withdrawn for laboratory studies. The patient is then placed in the prewarmed cabinet. A Leeds and Northrup Micromax strip chart recorder with a range of 90 to 110 F. is used to record patient's rectal temperature throughout the session (fig. 1). The pulse and respiration are charted at 15-minute intervals and the blood pressure is taken every 30 minutes, or oftener if abnormal. An especially trained graduate nurse constantly attends each patient during the treatment. One of our medical group is in the office at all times prepared to treat any emergency. Every therapeutic aid for emergencies is instantly available, including intravenous solutions in liter flasks, carbogen and stimulants. We feel that we are thus able to administer treatments in our office as safely and satisfactorily as in the hospital.

The sedative usually employed, in addition to seconal gr. 1½ taken on arrival, is pantopon gr. 1/3 by hypodermic injection when the patient's temperature is 101 to 102 F. During long treatments pantopon gr. 1/6, or

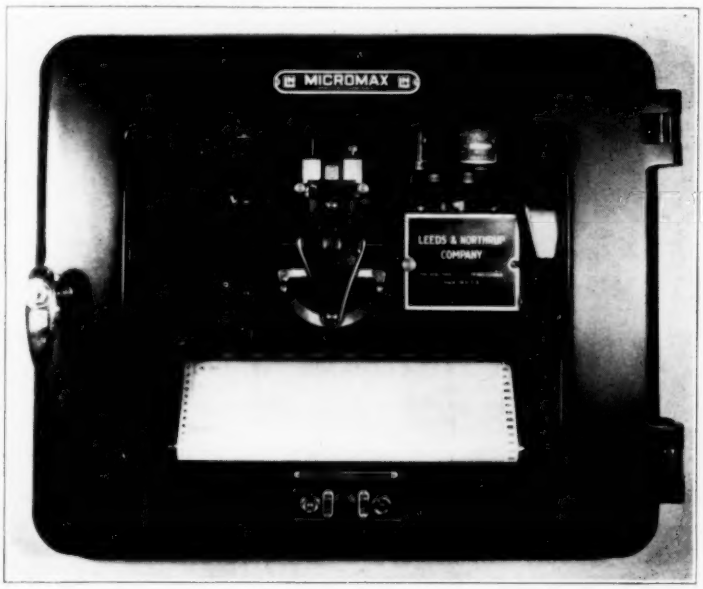

Fig. 1. — Leeds and Northrup Micromax Resistance thermometer. Range 90-110 degrees F. Used to constantly record the patient's rectal temperature.

dilaudid gr. 1/40, may be repeated once or twice to control restlessness. The patient's temperature usually reaches the desired level in one and a half hours. This point constitutes the starting time of the treatment. During treatment the patient is allowed to drink 200 to 400 cc. of fluid per hour. The fluid most commonly used by us is Calso water, a slightly charged alkaline water containing calcium carbonate, magnesium carbonate, sodium phosphate, sodium chloride and sodium bicarbonate in physiologic solution. This water is much more palatable than salt water and has greatly reduced the incidence of nausea and vomiting. Very rarely is it necessary to resort to the intravenous route to maintain adequate fluid balance.

When the treatment period is over the cabinet is opened and the patient's temperature allowed to return to normal. This requires from one to one and a half hours. Following these long treatments the patient is given an alcohol rub and moved by ambulance to a nearby hospital for observation and rest. The average length of hospital stay in this series was 1.6 days.

Methods of Treatment

We use two fever cabinets of the circulating warm, moist air type (fig. 2). Our third cabinet uses inductothermy for the elevation of temperature. We have been able to observe no physiologic difference or variation in comfort between these so-called external and internal methods of heating. The type of apparatus, in our opinion, is of far less importance than the skill of the personnel. The one most important attribute of a fever cabinet is its ability to generate and maintain high relative humidity. In a well designed apparatus the patient's rectal temperature can be maintained between 106 and 107 F. with an environmental temperature not exceeding 110 degrees providing the humidity is of the order of 90 per cent saturation. Under such conditions dehydration seldom occurs. In the rare cases in which it does occur, we administer intravenously 5 per cent dextrose in normal saline solution.

Fig. 2. — Fever cabinet of the circulating warm moist air type.

Another advantage of low cabinet temperature and high humidity is the virtual absence of skin burns. With the older method of low humidity and relatively higher temperature, skin burns and blisters occurred frequently. On several occasions it was necessary to terminate treatment for that reason alone.

At rectal temperatures of 106.7 F. the pulse rate will average 130 to 140 and the respiration will be 26 to 28. The systolic blood pressure characteristically shows an initial rise during induction of 10 to 20 mm. (fig. 3).

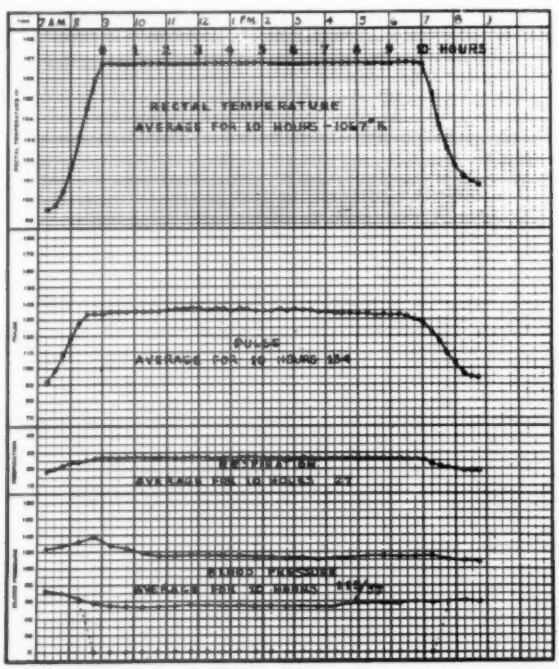

Fig. 3. — Temperature, pulse, respiration and blood pressure chart during 10 hour fever treatment at 106.7 degrees F. (Average of 50 cases.)

During fever maintenance the systolic pressure will vary between normal and 20 mm. below normal. Diastolic blood pressure during fever is about one-half the systolic; for some reason not known to us it may be heard down to zero pressure in many cases. A systolic blood pressure below 80, a pulse

pressure less than 20 and a pulse rate above 160 lasting for more than half an hour ordinarily call for termination of the treatment.

During the period from July, 1936, to December, 1937, before our use of combined sulfanilamide and fever therapy, 134 patients were treated for gonococcic infection (table 2). Each patient in this series received at least

TABLE 2.—*Results of 134 Patients Treated with a Single Fever Session at 106.7 Degrees F., without Sulfanilamide.*

Duration of Fever	No. Patients	No. Cured	% Cured	Remarks
1-6 hours	21	4	19%	
8-9 hours	8	4	50%	
10 hours	100	87	87%	Of the 13 failures, 5 pts. were given a second fever of 10 or 12 hrs. duration. Four were cured.
12-15 hours	5	4	80%	One pt. with g. c. endocarditis failed to be cured. He died of his endocarditis 3 weeks following the fever therapy.

three subsequent examinations to determine the presence or absence of the gonococcus. In women, two of these examinations must be post-menstrual. Since July, 1937, routine cultures have been made on material obtained from these examinations in addition to the usual smear stained by Gram's method. The majority of these patients was observed for three or more months following fever therapy and many more examinations were made than the minimum stated above. Twenty-nine patients did not complete the single 10-hour session planned for them due to lack of co-operation or because they developed physical signs which made the termination of treatment advisable. Of these 29 patients, 8 were cured following a single short fever session. Of these 8 patients who were cured, one received only 5 hours, 3 received 6 hours, 1 received 8 hours and the remaining 3 received 9 hours of fever. Five patients were arbitrarily given fever longer than 10 hours, 4 being of 12 hours and the fifth of 15 hours duration. Four of these 5 were cured. The fifth, a 34 year old man with a terminal gonococcic endocarditis, was subjectively improved for some time, but his blood culture again became positive on the 4th day and he died 3 weeks later of his pre-existing disease.

The remainder of this group, consisting of 100 patients, received a single hyperpyrexia treatment of 10 hours at a rectal temperature of 106.7 F. Of these 100 patients with adequate follow-up, 87 were found to be consistently free of gonococci following the single 10-hour session. This represents a rate of cure of 87 per cent. Sixty-three patients had had their disease an average of four weeks before fever therapy and were classified as acute. There were 10 failures in this group (84 per cent cures). Of the remaining 37 patients who had chronic gonorrhea, 3 failed to be cured (92 per cent cures). The average duration of the disease before fever therapy in the chronic cases had been 5.4 years. Nineteen of these chronic cases had carried their infection from 5 to 22 years before being finally cured with artificial fever. Of the 13 patients not cured after a single 10 hour fever session, 5 were given a second treatment of 10 or 12 hours. Four of these were cured after the second treatment.

Included in the 134 cases in this series is virtually every complication common to gonococcic infection: prostatitis, cowperitis, epididymitis, seminal vesiculitis, periurethral abscess with fistulae, arthritis, salpingitis, bartholin-

itis, proctitis, peritonitis, ophthalmia, septicemia and endocarditis. All complications, with the single exception of endocarditis, have shown an excellent response to treatment. Relief of pain in epididymitis, salpingitis and arthritis is often dramatic following hyperpyrexia.

Sulfanilamide and Thermotherapy

With the introduction of sulfanilamide and its related compounds there was a period of several months during which no patient received fever treatment for gonorrhea in our office. It seemed for a time that the use of fever in the treatment of this disease might be relegated to the past. However, as the number of failures from sulfanilamide increased, we again turned to fever therapy for aid in these sulfanilamide-resistant cases. At this time Ballenger, Elder and McDonald published a preliminary report on the treatment of gonococcic infections by combined sulfanilamide and thermotherapy.[5]

In combining fever therapy with sulfanilamide chemotherapy we instruct our patients to take 20 gr. of sulfanilamide four times a day for two days preceding fever therapy. On the morning of the fever treatment they take 20 grains of sulfanilamide one hour before reporting. A fever session of 5 hours is then given and is repeated every other day until three treatments have been given. Sulfanilamide gr. 20 four times a day is administered on the alternate days (table 3).

Table 3. — *Outline for Combined Sulfanilamide and Fever Therapy in the Treatment of Gonorrhea.*

1st Day	2nd Day	3rd Day	4th Day	5th Day	6th Day	7th Day
Sulf. gr. 20 q. i. d.	Sulf. gr. 20 q. i. d.	Sulf. gr. 20 in A.M. 5 hrs. Fever at 106°	Sulf. gr. 20 q. i. d.	Sulf. gr. 20 in A.M. 5 hrs. Fever at 106°	Sulf. gr. 20 q. i. d.	Sulf. gr. 20 in A. M. 5 hrs. Fever at 106°

In the first 19 patients so treated the rectal temperature was elevated to only 103.5 degrees for the five hour period. In these 19 patients, there were 5 failures, a cure rate of only 74 per cent. At this time we altered the above procedure by increasing the temperature plateau of the 3 fever treatments from 103.5 to 106 F. All other factors remained the same.

Up to August 1, 1939, 49 patients have been treated by this higher temperature routine with only 7 failures, a cure rate of 86 per cent. We therefore have abandoned treating at the lower temperature level of 103.5 F. because of the significantly higher rate of cure which follows the higher temperature level. Taking these two groups as a whole our statistics show 68 patients with 12 failures (table 4). Fifty cases were acute with 10 failures

Table 4. — *Results of 68 Patients Treated with Combined Sulfanilamide and Fever Therapy.*

Rectal Temp.	No. Patients	No. Cured	% Cured
103.5°	19	14	74%
106°	49	42	86%

and there were 2 failures in 18 chronic cases. There were 10 failures in 54 male and 2 failures in the 14 female patients treated. We wish again to emphasize that, with one exception, this combined treatment has been used only in cases found resistant to sulfanilamide and local therapy.

In each of these cases a blood sulfanilamide level is determined at the beginning of each fever treatment after the method of Proom.[6] A blood level of 10 mg. per cent is considered satisfactory. Experience has shown that the combined treatment is much less effective in patients who do not concentrate the drug to this level.

The advent of sulfanilamide has greatly simplified the treatment of gonorrhea. This drug combined with mild local treatment results in cure in 80 per cent. We can cure 86 per cent of the remaining 20 per cent by combined chemotherapy and artificial fever therapy. A combination of these two figures shows that success follows these simple measures in 97 per cent of the cases. Fever in these patients does not entail risk. Five hour fevers at 106 F. may be safely given to individuals who could not tolerate 10 hours at 106.7 F. Patients receiving 5 hour fevers are not sufficiently fatigued to require a stay in the hospital.

Thermal Death Time

For the unfortunate 3 per cent not cured by sulfanilamide or combined chemo- and thermotherapy, a thermal death time fever should be considered. Apparatus for determining the in vitro thermal death time of the gonococcus was installed in July, 1937. A description of the procedure has been published elsewhere.[1,2]

Because of the limited number of cases suitable for such treatment, our series is limited to five patients who have received a fever equal to the thermal death time of their own strain of gonococcus. Four patients, 3 males and 1 female, have been given thermal death time fevers of 12, 13, 14 and 18 hours with complete cure. These patients were not only sulfanilamide-resistant but also were not cured by three 5 hour fevers at 106 F., combined with sulfanilamide (table 5).

TABLE 5. — *Analysis of 5 Patients Treated with a Single Fever at 106.7 Degrees F. Equal to the Thermal Death Time of Their Particular Strain of Gonococcus.*

Date	Patient	Age	Sex	Duration of Fever	Result	Remarks
1-18-38	F. P.	25	F	13 Hours	Failed to Cure	G. C. Endocarditis and Septicemia. Died 2-10-38 from pre-existing endocarditis.
6-28-38	C. R.	29	M	13 Hours	Cured	Previous failure from combined Sulfanilamide and fever therapy.
8-18-38	M. M.	31	F	14 Hours	Cured	Ditto
8-29-38	W. A.	22	M	18 Hours	Cured	Ditto
1-24-39	C. B.	29	M	12 Hours	Cured	Ditto

The fifth patient was a 25 year old female with gonococcic septicemia and endocarditis. She had previously taken large quantities of sulfanilamide without result. A thermal death time fever of 13 hours at 106.7 F. also failed to cure her. The thermal death time was repeated on a blood culture obtained after fever therapy and again found to be 13 hours. This apparent failure of a thermal death time fever may be explained on the basis that this patient's infection was systemic and undoubtedly present in areas, such as the skin of the face and alveoli of the lungs, the temperature of which cannot be maintained at the rectal level.

In every case these long thermal death time treatments were very well tolerated. Hospital stay of the first four patients was only for one day or less. These cases, however, require very careful selection. We feel that this arduous procedure should be used only after combined chemotherapy and fever therapy has failed to rid the patient of his infection.

Summary

1. A series of 100 consecutive patients treated for gonorrhea with a single 10 hour fever session at 106.7 F. (rectal) is presented. The incidence of cure was 87 per cent.

2. Sulfanilamide and its related compounds provide a simple treatment for gonococcic infections, which when combined with mild local treatment is effective in 80 per cent.

3. A plan is outlined for combined chemotherapy and artificial fever in patients resistant to sulfanilamide and local treatment. This combination has cured 86 per cent of these resistant cases.

4. For the few cases not cured by these combined efforts we would suggest giving a fever equal to the in vitro thermal death time of the patient's own strain of gonococcus. This method will result in an incidence of cure approaching 100 per cent.

5. The more simple and less hazardous methods should be tried before resorting to the long fevers ordinarily required in the thermal death time procedure.

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Note: Discussions will appear in a later issue. Ed.

A UNIVERSAL INSTRUMENT FOR CORRECTIVE EXERCISES

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Orthopedic gymnastic exercises are designed primarily to achieve re-education of various muscle groups, with the aim of providing good body posture and normal function of the extremities. Since the main centers of postural strength are the abdominal, shoulder and pelvic muscles, it is chiefly to the training of these that corrective exercises are directed.

Posture is the result of active muscle forces overcoming the effects of gravity. The absence of good posture or, conversely, the presence of incorrect posture may lead to circulatory, respiratory, or metabolic deficiencies, as well as to irreparable bony deformity. The apparatus we have designed is aimed at the correction of poor posture and the prevention of the disturbances in its wake.

Exercise of various muscle groups, which strengthens them for the performance of their role in correct posture and provides for their adequate function, is best carried out when the force of gravity is partially or completely eliminated. The muscles are then permitted to contract to their maximum. The most common method of achieving this diminution of gravitational effect is by means of underwater activity, today generally accepted as an invaluable aid in the re-training of muscles affected by poliomyelitis.

However, because underwater gymnastics necessitate complicated and expensive apparatus, as well as the presence of a pool in which the therapy may be carried out, the present alternative method offers certain advantages. There is little difference in the effectiveness of land and water exercise in producing muscle recovery, according to Hansson. The pool merely offers a more attractive medium; the water relaxes antagonistic muscles, produces mild massage and gives the patient a feeling of security through its buoyant effect. A series of monotonous calisthenics is converted into a pleasant diversion.

Description of Apparatus

It has been our aim to duplicate these advantages, so far as we could, in a gymnastic apparatus which could be inexpensively made for use in a gymnasium, hospital or office.

The device consists of a swimming belt provided with variable counterweights (fig. 1), a gymnastic ladder (figs. 1 and 2) equipped with a weak foot frame, a stretchometer and a set of pulleys (fig. 3), and a correction bar frame (fig. 4). By means of these, active exercise of isolated muscles or of several muscle groups, with the patient in prone, supine or lateral trunk position, may be carried out, while gravity is partly or completely eliminated by suspension or counterweight. Stretching exercises, passive correction of spinal deformities and foot manipulation are provided by the various attachments.

The Swimming Belt is the first element in the device (fig. 1). It consists of four movable, adjustable canvas bands [3] attached to two hollow pipes about 30 inches long. The pipes are maintained at a distance of 15 inches from each other by an arched bridge 18 inches high [1]. A U-shaped tube 15 inches long

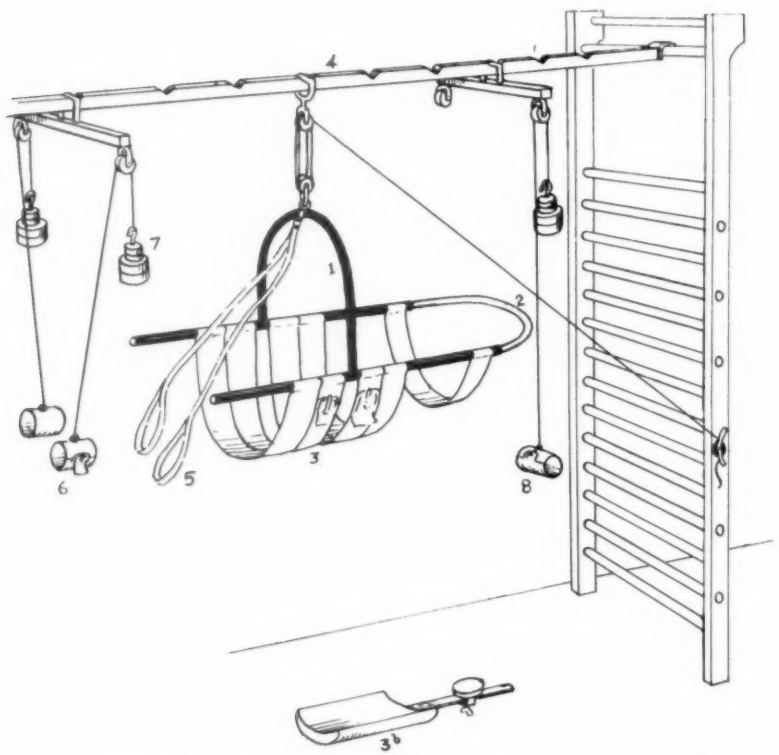

Fig. 1. — Apparatus for hospital or office with swimming belt and counterweight attachment, gymnastic ladder, foot frame and pulleys.

may be telescoped into the metal frame to serve as a head support if necessary (fig. 1 [2]). The belt hangs from a ceiling bar 60 inches long, equipped with a ratchet in which a pulley cord may be inserted (fig. 1 [4]). The canvas bands, each 4 inches wide, support the patient. The distal strap is placed low under the buttocks; the uppermost strap supports the shoulder blades. Two pelvic bands affixed to the bridge (fig. 1 [5]) hold the legs and prevent slipping. A plaster shell (fig. 1 [3b]) with an adjustable sternal pad may be inserted in the belt to provide additional support. Partial or complete elimination of the effects of gravity on the extremities is secured by interchangeable counterweights running over hinged arms 12 inches wide (fig. 1 [7]) attached to a movable cross bar 15 inches long. These are connected with *turnbuckle* cuffs for the extremities (fig. 1 [6 and 8]).

Gymnastic Ladder. — This, the second part of the apparatus, measures 93 inches in height, is 35 inches wide and is fitted with fourteen cross bars 3½ inches apart. It is fastened to the wall, but may be swung away to a right angle and fixed by a floor bolt (fig. 2 [2]). In this position, it is accessible from both sides. The apparatus is also adjustable at different inclinations by fixation hooks (fig. 2 [2]). This allows suspension of the patient in a glisson sling using a redression cushion under the shoulder blades, and makes possible stretching and extension exercises.

Belt and Ladder Exercises

The patient is placed in a chair while the belt is fastened, and is then hoisted into the air. In this position exercises of the extremities and of the trunk muscles may be carried out, particularly for poliomyelitis and scoliosis patients.

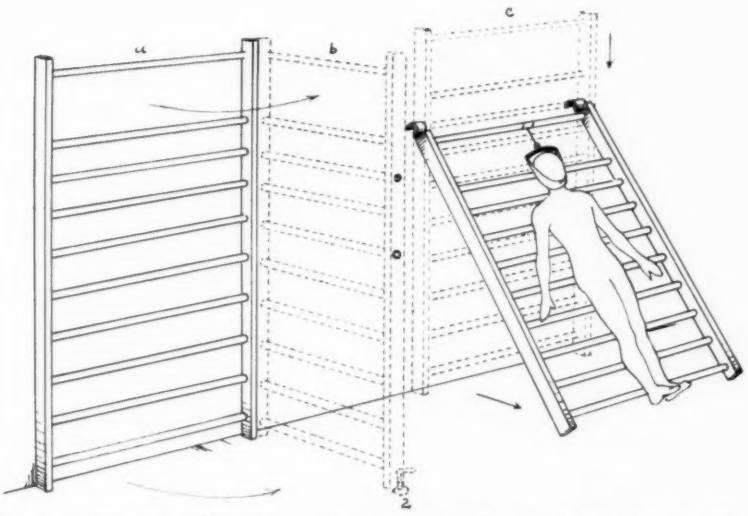

Fig. 2. Gymnastic ladder with special attachments of floorbolt [2] and fixation hooks for adjustable inclination at desired angles.

The swimming belt calisthenics are done by means of the belt and ladder; among the possible maneuvers are:

1. Breast stroke swimming exercise. The distal canvas band is placed at the level of the trochanter, the proximal band under the lower sternum. The hands are held together under the chin and a swimming motion is performed in triple tempo: (1) stretching, (2) abduction, and (3) adduction. Analogous knee flexion, abduction and adduction accompany the arm movements. Inhalation takes place during the first part of the exercise, exhalation during the second. This procedure is an aid to general posture and is of special value in strengthening the back muscles.

2. Gluteal exercise. The patient is placed in the same position as in exercise 1, but the hands grip one of the horizontal bars and the pelvic straps are adjusted to prevent slipping. The legs are raised straight upward, either separately or together. If desired, a sandbag may be placed over the ankles to provide resistance. Partial or complete elimination of leg gravity may be secured where the muscles are paretic or paralytic, by adding counterweights to compensate for the muscular deficiency.

3. Shoulder exercise. The patient lies prone, with both arms maximally abducted, the hands grasping the next higher bars on the ladder. An assistant holds a hand pressed against the tips of the shoulder blades. This exercises the shoulder muscles and helps to correct round shoulders. The patient may be allowed to relax by being lowered to the floor or by resting on a low chair in the prone position.

Another form of this exercise is done in the same prone position, but the feet are hooked over one of the ladder rungs and the patient faces in the opposite direction.

4. Abdominal muscle exercises. The first is something of a backstroke swimming activity. The patient lies in the supine position, the distal canvas band under the sacrum, the proximal band under the tips of the scapulae. The supporting head rest is placed in position. The patient places the hands at the back of the neck and alternately flexes and extends the knees.

Another possible exercise in this position consists of stretching the legs one at a time or both together. The legs may be abducted and adducted, or circles in the air may be described with them. Additional weight may be at-

tached to the ankles for resistance, or the body weight can be counterbalanced by a sandbag counterweight.

5. Scoliosis exercises. The patient lies on the concave aspect of the curvature. The upper leg (convex side) and the lower arm (concave side) are raised, while the head and chest are lifted. The canvas bands press against the vertex of the curvature.

The patient may lie prone with the feet hooked on the ladder, the arm on the concave side held to the neck, the arm on the convex side pressed against the curvature. The chest is inclined to the convex side and then is returned to the midline.

Derotation is achieved by holding the body in the same position, but grasping the bars with the hands instead of with the feet. The next lower bars are held and the convex side of the body rotated downward.

Another derotation exercise uses the ladder only, without the swimming belt. The patient holds on to the upper bars, while his body is swung through the space left by the removal of several lower bars. The intervening rungs produce counter pressure against the curvature.

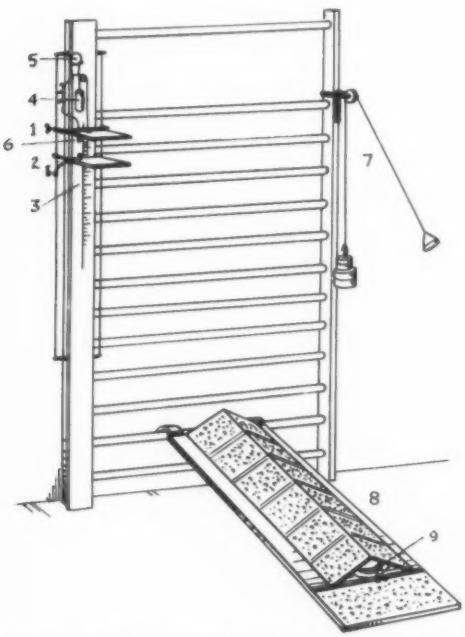

Fig. 3. — Stretchometer attachment to ladder [1 to 6] for correction of posture; foot frame for gymnastics of weak feet [8]; pulleys for flexion-extension exercises.

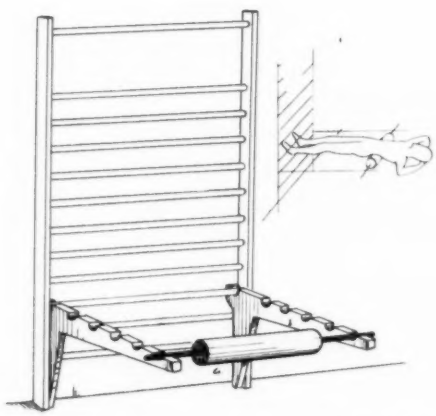

Fig. 4. — Corrective frame attachment to ladder to overcome scolioses and spine deformities and strengthen weakened muscles of back and abdomen.

Stretchometer. — An attachment to the gymnastic ladder is a "stretchometer" (fig. 3 [1 to 6]) which consists of a wooden board (fig. 3 [2]) gliding in two trolleys (fig. 3 [2b]) and balanced by counterweight (fig. 3[4]). The board is adjusted to rest on the head of the patient as he stands in relaxed position. Above this board is another (fig. 3 [1]) adjusted so that the patient can reach it by stretching to the greatest extent. We have arranged an electrical contact so that a bell rings when the lower board is pushed upward to a maximal extent (fig. 3 [5, 6]). This is a modification of the Spitzy method, which, we find, shows the exact amount of extension possible and measures the increase in this amount after postural exercise. There is a definite loss of elas-

ticity in poor posture, irrespective whether this is due to fixed curvature or to general fatigue.

We have established a postural coefficient or index, determining the relationship between chest expansion and spine extension:

$$\frac{\text{Extension ability.}}{\text{Exhalation period.}} = \text{equals Postural Coefficient.}$$

During the stretching procedure the patient exhales, hissing the breath out of the mouth with the tongue between the teeth. The period of exhalation, measured in seconds, forms the denominator of the above fraction, while the extent of spine extension, measured in inches, forms the numerator. Increase of the coefficient indicates an increase in vital capacity. In scoliosis patients this is extremely important, since 95 per cent show diminished air intake.

Weak Foot Frame. — A ladder (fig. 3 [8]) can be hooked to the cross bars of the gymnastic ladder at different levels to provide appropriate exercise for patients with weak feet. This attachment consists of two walking boards each 30 inches wide, covered with gravel, meeting at an inverted V angle, and provided with small gripping bars. The frame may be adjusted at different angles of inclination.

Pulleys. — A set of pulleys (fig. 3 [7]) may easily be affixed at one side of the ladder so that flexion-extension exercises of the upper extremity are possible. The weights are, of course, interchangeable. Two pulleys make it possible to give shoulder exercises, the pectoral muscles being stretched as the patient sits with arms abducted and stretched backwards.

Scoliosis Correction Frame. — This frame (fig. 4 [2]) consists of two supporting arms 40 inches long, on which is an adjustable roll, 33 inches long and 3½ inches in diameter. By suitable exercises with this mechanism, correction of spine deformities is furthered and the abdominal and back muscles are strengthened. The body weight provides resistance.

For the correction of round shoulders, the patient lies on the roll with his feet hooked in the ladder bars, the roll against his shoulder blades and his hands held at the nape of the neck. The body is stretched back as far as possible (fig. 4 — insert).

For exercise of the abdominal muscles, the patient sits on the correction bar, hooks his feet in the ladder, holds his hands at the nape of his neck or straight overhead. He then bends the trunk backward and returns to the upright sitting position, exhaling on the backward motion and inhaling on the forward one.

For treatment of scoliosis, the patient lies on the side of outward curvature, bends over the correction bar with arms extended. The arms are then returned to the horizontal plane. A rotary movement may also be added.

Summary and Conclusions

A new apparatus is described, which includes a swimming belt, gymnastic ladder and various attachments, making possible certain exercises valuable in the correction of poor posture or spinal deformity. Since with its use the effects of gravity are partially or completely eliminated, it affords a useful substitute for underwater exercise, particularly in poliomyelitis cases. Since it is also relatively inexpensive to construct, its use is possible for postural exercise where no therapeutic pool is available.

The whole apparatus, including swimming belt, gymnastic ladder, weak foot incline and correction roll, may be built for approximately $75.00.

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A LABORATORY METHOD FOR THE PRODUCTION OF FEVER *

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One hundred and sixty-four years ago Blagden[1] suggested that disease of man be treated by fever produced in a superheated room. This suggestion was not based on the empiricism of centuries of hot bath and steam room therapy, but rather on shrewd experimentation with human and animal subjects. Using the newly invented mercury thermometer, Blagden reported an elevation of the body temperature of normal subjects who were placed in a room heated either by moist air to 120 F. or by dry air to 220 F. He made this statement: "The heated room will, I hope, in time become a very useful instrument in the hands of the physician.[2]" That his hope is being fulfilled, all of us here realize.

Since Blagden's time, methods for experimental production of fever have progressed steadily. Subject to minor modifications, the basis of physical methods of producing fever is either a high frequency current or a high environmental temperature. This paper is concerned only with experimentation on animals in which fever was produced by means of the latter method.

The procedure usually requires that the body of the animal be placed in a heated cabinet similar in arrangement to one used in the production of fever of man. In the method to be described the anatomic application is different, in that the cabinet encloses only the head of the animal.

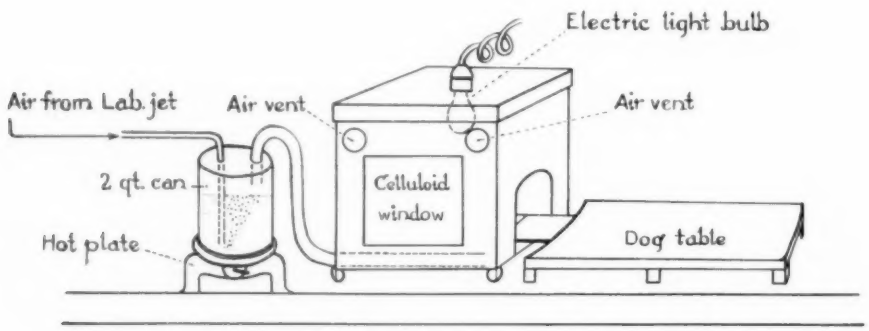

Fig. 1. — Head cabinet used to produce hyperpyrexia in animals.

The physiologic basis for such a procedure is sound. It is known that in the dog — and this is true of most furred animals — excess heat of the body is dissipated almost entirely through the respiratory system, and only slightly through the skin. The mechanism for dissipation of heat, therefore, is virtually the opposite to that of man. Because of this mechanism, it is possible to raise the temperature of the body of the animal simply by raising the temperature of the

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* Abstract of thesis submitted by Dr. Bennett to the Faculty of the Graduate School of the University of Minnesota in partial fulfillment of the requirements for the degree of M. S. in Physical Medicine.

air which it breathes. We have done this by enclosing the head in a cabinet heated by warm, moist air (fig. 1).

Experimental Method

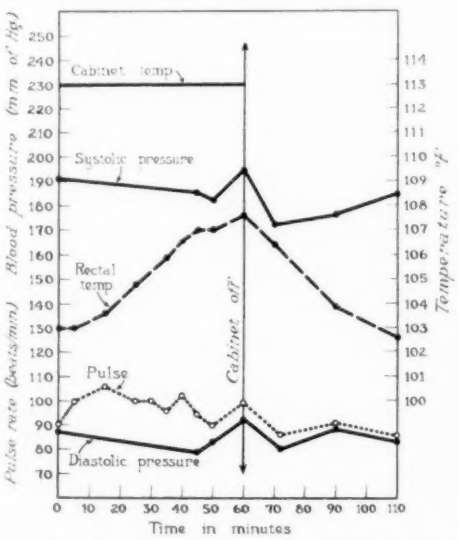
The cabinet is approximately 1½ foot wide, 1 foot deep, and 1 foot high. The roof, which can be lifted, is of wood and the rest of the cabinet is constructed of sheet metal. One side has an opening large enough to admit the head of a dog. In the other sides are celluloid windows and air vents.

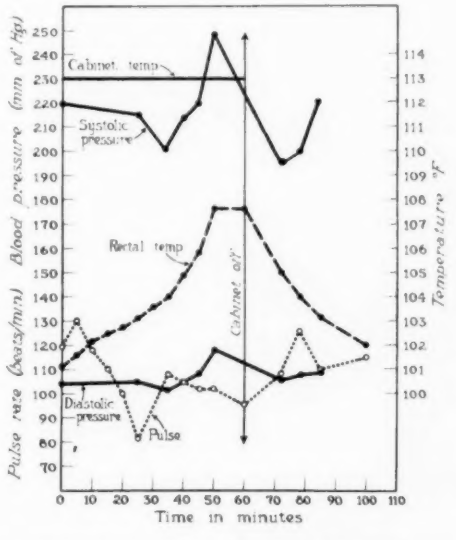
The air that is introduced into the cabinet is made warm and moist, by causing air from the usual laboratory jet to bubble slowly through a gallon of water, the container of which rests on a small hot plate. The air is then forced through rubber tubing into a lower front corner of the cabinet.

The dog is fastened to the animal board either on his side or back, and his head is inserted into the cabinet. A tube of rubberized cloth fastened to the outside of the opening in the cabinet closes the space between his neck and the opening. Anesthesia is not needed. A well trained dog will lie quietly during the entire course of fever.

A thermometer is inserted through a hole in the top of the cabinet and is so adjusted that the bulb is to one side and level with the dog's mouth. An electric light is built into the roof, to be used momentarily to read the thermometer or to observe the head of the animal.

In our present work, only highly humidified air has been used. This has enabled us to employ a relatively low air temperature because loss of heat from the body, consequent on evaporation over the mucous surfaces of the respiratory tract, was minimized. Also, the moist air helped to maintain adequate fluid balance of the animal. We found that the air heated to 113 F. was sufficient to raise the rectal temperature of the dog to 109 F. or more, within forty-five to ninety minutes. It is to be emphasized that adequate circulation of air was maintained through the several air vents.





Figs. 2 and 3. — Physiologic response of dog during hyperpyrexia produced by use of head cabinet.

A detailed report of some experimental work with this cabinet is to be published later. Here, briefly, we shall mention several observations made in the course of this work. Figure 2 represents a typical experiment. With the air in the cabinet kept at approximately 113 F., the rectal temperature of the animal

rose from 102.8 to 107.8 F. in sixty minutes. The cabinet was then removed and the temperature of the animal's body fell to normal in fifty minutes. The pulse rate remained practically unchanged throughout the entire experiment; certainly no significant change occurred. The arterial pressures were obtained directly from the femoral artery by a Hamilton manometer and were recorded on a photokymograph. Here again little change was noted, particularly in the diastolic pressure.

Figure 3 represents a similar experiment. With the air within the cabinet kept at approximately 113 F., the rectal temperature rose from 101.1 to 107.6 F. in fifty minutes. During this period the pulse rate dropped from 120 to 102 beats per minute. The systolic pressure rose from 220 to 248 mm. of mercury, but the diastolic pressure remained practically unchanged.

The failure of the pulse rate to parallel the rise in bodily temperature might be explained in part on the basis of the ratio existing between the pulse rate and the cutaneous temperature. This ratio was noted by Benson,[3] Phillips and others.[4] Benson, in 1934, stated that theoretically fever could be induced without increasing the pulse rate. Our experiments bear out his prediction, at least as far as animals are concerned. They further direct attention to the fact that high humidity, combined with relatively low air temperature, is important in maintaining a low cardiac rate during the induction of fever in man by physical means.

The failure of the diastolic pressure to fall as fever is produced is somewhat more difficult to explain. Theoretically it can be assumed that when the animal is subjected to heat in this manner the pulmonary vessels must be markedly dilated. However, it cannot further be assumed that a peripheral vasodilatation also will take place. In fact, peripheral vasoconstriction is more likely, as the body is exposed to room temperature and does not in itself act as a major means of dissipation of heat. Pinkston[5] found that actual vasoconstriction occurred when fever of rabbits was produced by injection of typhoid vaccine. If this takes place in dogs which are subjected to heat in this head cabinet, then the maintained peripheral resistance might explain the maintained level of diastolic pressure.

Further discussion of the physiologic response is beyond the scope of this paper. Our hope is that this simple method of producing fever of animals may be of interest and perhaps of assistance in future experimental studies.

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Note: Discussions will appear in a later issue. — Ed.

WATER EXCRETION DURING GENERAL HYPERTHERMY BY PHYSICAL MEANS *

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Water metabolism during general hyperthermy (pyrexia) produced by physical means (physicopyrexia) has been studied by Walinski,[28] Neymann,[18, 19, 20] Warren,[20] Gibson,[9, 10, 11] Phillips,[21] Finkelstein,[5] Richet, Jr.,[24] Binet and Burstein,[3] Krusen and Elkins,[15] Pijoan,[22] and their collaborators. However, we have been unable to discover any data in the literature which describes the manner in which the human organism utilizes water excretion in attempting to overcome the effects of the heat during hyperthermic treatment. Therefore, we have attempted to ascertain experimentally how much water is lost by the cutaneous perspiration and by pulmonary evaporation. In these experiments we used an inductotherm with an air conditioned cabinet and a Kettering hypertherm.[2]

In 1882, Frédéricq[6] showed that the breathing of hot humid air, while the body is at ordinary room temperature, produces a vasodilatation of the skin. In our experiments these conditions were reversed. We first measured the water output of man during treatment and later experimented on dogs. The temperature of the room was 20 to 22 C. with 60 per cent humidity.

Measurements of Water Excretion

At rest, a man excretes 20 Gm. of water per hour through his skin. During hyperthermy this perspiration, which is rapidly absorbed by the sheet wrapped around his body, is impeded by the humidity of the atmosphere in the cabinet. The perspiration of the surface of the skin within the cabinet was not measured because this would have been very difficult and because it does not cool the body perceptibly. Both the elimination of water by the lungs and by the skin and mucous membranes of the head was carefully measured.

Elimination of Water Through the Lungs. — The amount of water eliminated through the lungs was determined by means of a respirator with valves similar in construction to a gas mask (fig. 1, *A*). A layer of silica gel about 80 cm. square and 3 or 4 cm. in thickness absorbs the water from the expired air. The resistance is equal to a pressure of 3 millimeters of water. Between tests the respirator was warmed in order to avoid a condensation of water vapor on its walls after it was put in use. At the beginning of the experiment the chamber containing the silica gel was replaced by a gas meter in order to measure the respiratory volume per minute and for each intake of breath. Two patients were given several treatments in the cabinet of the inductotherm and in the hypertherm. Another patient was treated both in the cabinet of the inductotherm and in that of the hypertherm.

The results varied greatly with the individual patient, but they were relatively constant for the same patient during several hyperthermic sessions. Pulmonary evaporation is low; it ranges between 270 and 754 mgr. per minute for the rectal temperatures of 37.4 C. and 40 C. respectively. This corresponds to 0.151 and 0.423 calories per minute.

In man, therefore, pulmonary evaporation is quite ineffective and plays a minor role in the attempt of the body to cool itself, when its internal tempera-

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* Translated by Dr. Clarence Neymann, Chicago.

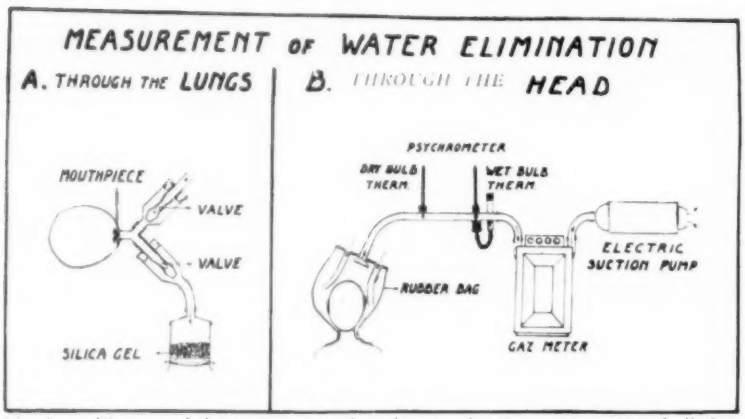

Fig. 1. — Diagram of the apparatus used on humans for the measurement of elimination of water by the lungs and of evaporation by the skin and the mucous membrane of the head.

ture rises. No differences were noted between artificial fever induced by the inductotherm or by the hypertherm.

Water Elimination Through the Skin and the Mucous Membranes of the Head. — In order to make this determination the head of the patient was enveloped in a large rubber bag through which a current of air was sucked at a rate of 600 to 900 litres per minute by means of an electric air pump (fig. 1, *B*). This air first passed through a tube in which a dry and a wet bulb thermometer had been inserted, then through a gas meter. It is advisable to make the tubing as short as possible and to see to it that its diameter does not vary too much. The volume of air passing through the machine in a definite time interval and the average difference of the temperatures between the two thermometers were noted. Thus the amount of water vapor per cubic meter and the percentage of humidity of the air were calculated by referring to psychrometric charts. Also the amount of water vapor passing through the machine per minute was calculated. A preliminary record was made as soon as the patient was placed in the cabinet. Later, as the temperature rose, other readings were recorded for each increase of a degree Centigrade in rectal temperature.

These figures obtained by direct measurement evidently did not represent the absolute values we were seeking. It was necessary to subtract the amount of humidity of the air of the room amounting to 55 to 60 per cent saturation at 18 C. or 10 to 11 Gm. of water vapor per cubic meter of air and also to subtract the amount of water eliminated through the lungs. For example, before the experiment was begun our measurements showed 11 Gm. of water per cubic meter of air corresponding to a saturation of 54 per cent or 0.55 Gm. of water vapor passing through the machine per minute. As soon as the patient had been placed in the cabinet, the humidity rose to 15.6 Gms. per cubic meter, a saturation of 65 per cent or 1.31 Gm. of water vapor passing through the machine per minute; 0.340 Gm. of water vapor was eliminated by the lungs per minute. Therefore the patient eliminated 1.31 Gm. minus 0.55 Gm. minus 0.340 Gm. equal to 0.420 Gm. of water per minute through the skin of the head.

The absolute values calculated in this manner certainly were not nearly as interesting as the increase of water eliminated during an hyperthermic treatment. When this increase was studied it became evident that the effort of the body to counteract the hyperthermy and cool itself depends mainly on the action of the skin and the mucous membranes of the head. The amount of water excreted gradually rose from 1 to 4.16 Gms. per minute. One Gm. of water is equivalent to 0.56 calories. Therefore, this increase means that a primary normal cooling effect of 0.56 calory is increased to 2.33 calories per minute during the hyper-

thermic period.

The inductotherm and its cabinet and the hypertherm gave similar results. They are in accord with the data of Richet, Sr.,[23] d'Arsonval,[2] Rubner,[16] Galeotti,[7] Gautrelet,[8] Lefèvre,[16] and Ambard and Schmid.[1]

Animal Experiments

In our experiments with dogs we obtained data and results analogous to those secured from the investigation on human beings described above. An animal weighing 7 to 9 Kgs. was anesthesized. Chlorosane was used since Hemingway[12] states that morphine should be avoided. The trunk and the legs of the dog were enclosed in a box similar to the cabinet used in conjunction with the inductotherm. The air in this box was heated by means of an electric resistance coil. An electric fan was used for circulating this air.

One must remember that dogs do not perspire through their skin. During the early studies of increased respiration produced by the inhalation of heated air, care was not taken to separate true pulmonary respiration from the air passing through the upper respiratory passages. However, it was constantly observed that a definite increase in respiration did not take place if the animal was muzzled. Under these conditions a wide opening of the jaws is impossible. This is an essential condition for polypnea.

In the preliminary experiments we placed a funnel-shaped muzzle over the jaws of the dog thus keeping its mouth shut. This appliance, ordinarily used for basal metabolic rate determinations, was connected with a box using silica gel as an absorbent medium. The following results were obtained.*

TABLE 1. — *Quantity of Evaporated Water in Animal Hyperpyrexia.*

Temperature of the Inhaled Air	Respiratory Rate Per Minute	Respiratory Volume Per Minute	Amount of Water Evaporated Per Minute
36, 1° C.	18	7, 5 litres	87 milligrams
38, 8° C.	26	8, 5 litres	84 milligrams
39, 3° C.	44	8, 2 litres	96 milligrams

We next turned our attention to hyperthermic experiments with dogs. These experiments are somewhat comparable to those of Jacquot and Mayer with rabbits.[13] Instead of making successive measurements and determinations on man, as described above, we were able to calculate all factors simultaneously, when dogs were used.

The head of the dog was covered with a large rubber hood through which an air current was forced at the rate of 200 to 500 litres per minute. This air then passed through a psychrometer and a gas meter. A cannula was inserted in the proximal end of the trachea, just where it leaves the lungs and this cannula was connected to a respiratory apparatus with valves similar to the one described in figure 1, *A*. Thus the expired air could be passed through a layer of silica gel. It seemed best to determine the respiratory rate and the respiratory volume per minute by temporarily disconnecting the chamber containing the absorbent medium. The amount of water passing by the psychrometer minus the amount in the external air corresponded to the humidity evaporated through the mouth and pharynx.

Because a muzzle was used while the dog was being prepared and while it was being given the anesthetic by intravenous injection a rise in temperature usually occurred. This temperature abated after half an hour. This explains why our figures, as calculated in table 1, showed a slightly higher amount of water evaporation at the beginning of the experiment than later on.

* We refer to the reports of Keeton,[11] Eimer,[4] and Magne[17] in this connection.

Excluding this factor, the water evaporation doubled and rose to 13 and even 16 times its original level during a hyperthermic session. These values correspond to 0.18 to 0.78 calory per minute and increased as the febrile period was prolonged. This evaporation was aided by the movement of the outside air, which the increased respiration produced in the dead air space around the head.

The water evaporated through the lungs only tripled in the same period of time. The volume of the box in which the animal was confined was 0.230 cubic meter. Before the experiment it contained 0.587 Gm., after the experiment 2.453 Gm. of water vapor. Since the same air was constantly reheated and circulated by the electric fan, this increase of water at the end of the experiment, namely, 1.866 Gm. must have been due to cutaneous perspiration. This confirmed the results of Eimer.[4]

In conclusion we can state that pulmonary evaporation is only slightly increased in dogs undergoing general hyperthermy. The evaporation through the mouth and pharynx is greatly increased. This is the only really efficient method this animal possesses for cooling itself.

Conclusions *

1. During hyperthermy produced by the inductotherm or by the hypertherm the human organism attempts to overcome the rise in temperature by perspiration. Under these circumstances, while the body is inclosed in a humidified cabinet, the perspiration produced by the head is the only efficient cooling medium. The elimination of water by other parts of the skin and by the lungs does not play an important role in the attempt of the body to cool itself.

2. Under these conditions we were not able to observe any differences between the effects of hyperthermy produced by the inductotherm and the hypertherm.

3. Under the same conditions the physiologic defense of the dog against heat is much like that of man. However, the dog does not possess cutaneous sweat glands and therefore emits infinitesimal quantities of water by perspiration, far too little to be efficient. Since, therefore, the skin cannot act as an efficient cooling device, the body of the dog attempts to cool itself by a larger amount of evaporation in the widely opened mouth and pharynx.

4. Therefore, general hyperthermy in man can best be regulated by paying attention to the sweat produced by the skin of the head of the patient; especially by the use of electric fans and cold compresses. All other conditions being equal, thermal balance is best maintained by those patients whose heads perspire freely and regularly.

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(Concluded on page 238)

THE DANGERS OF ULTRAVIOLET RADIATIONS *

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The beneficial effects of ultraviolet radiations in the treatment of many systemic and cutaneous conditions are well known. The treatment of skin diseases with ultraviolet rays constitutes a major part of dermatologic practice. In fact, there are several skin diseases that could not be adequately treated without the use of either natural or artificial sunlight. There has been a tendency, however, to over-estimate the value of this agent in the treatment of visceral and cutaneous diseases. Some authors have contended that heliotherapy prevents many diseases and is valuable in the maintenance of normal health. It must be remembered that heliotherapy is not the panacea some would have us believe.

In a previous communication[1] I outlined the role of ultraviolet irradiation in the treatment of diseases of the skin and stressed the fact that these radiations are of great value in the treatment of many cutaneous disorders, but that they are dangerous when carelessly used. MacKee[2] has written extensively on this subject. In this paper only the harmful results which may follow exposure to ultraviolet irradiation will be discussed.

Harmful Effects of Irradiation

The most common undesirable reaction resulting from exposure to ultraviolet rays is ordinary sunburn, technically designated erythema solare or dermatitis actinica. Over-exposure to sunlight may cause only simple redness with slight pruritus. The erythema may be accompanied by a sensation of heat, and in a few days exfoliation may occur. This reaction is comparable to a first degree burn. If exposure has been overly prolonged, the reaction may be more severe. Not only is the erythema more pronounced, but there may be edema, burning and marked sensitiveness of the skin. Within a few hours after the appearance of the erythema, vesiculation may occur. This stage of sunburn is comparable to a second degree burn. There is always the danger of secondary pyogenic infection in this stage. Fortunately, erosions occur rarely, so that large ulcerated areas as in a third degree burn, are not seen following exposure to ultraviolet irradiation. Along with the cutaneous lesions there may be systemic symptoms. The most frequent ones are slight elevation in temperature, malaise, headache, vomiting and albuminuria. Within a few days to a week after exposure the symptoms begin to subside and recovery ensues. The severity of the sunburn will vary with the race, the color of the skin, the length of time of the exposure, the time of day and the local climatic conditions.

A few individuals who are peculiarly sensitive to the effects of ultraviolet radiation following a burn, may develop a papular, vesicular and erythematous eruption with considerable pruritus. Individuals so affected may either recover spontaneously within 2 or 3 weeks or go on to eczematization, which may require several weeks for complete recovery.

Some individuals who are sensitive to sunlight may develop lesions on the lips which simulate herpes simplex. This is seen quite often during the

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summer months when they are apt to over-expose themselves to the sun. The exact mechanism of the production of herpes is not understood. Rarely, these herpetic lesions may appear elsewhere on the body. The diagnosis is obvious as the grouped vesicles appear a day or two after a mild sunburn.

Some individuals react differently to the same physical agent. Urticarial lesions following exposure to ultraviolet irradiation have been noted on many occasions. Some of these lesions may be capped with vesicles or bullae, simulating bullous erythema multiforme. Hydroa vacciniformis (hydroa estivale) is a rare bullous disease which occurs mostly on the exposed parts of children during the Spring, Summer and Fall seasons. Patients with this disease show a marked increase in hematoporphyrin. The exact relationship between hematoporphyrin, other photosensitive drugs and hydroa vacciniformis is not definitely established. Summer prurigo is another condition which is said to be caused by exposure to the sun's rays during the summer months. The increased temperature is no doubt an additional etiologic factor. Melanosis, which follows sunburn and resembles chloasma and argyria, occasionally occurs in idiosyncratic individuals. This condition is disfiguring but is not especially dangerous. The fact that pellagrous lesions of the skin occur on the exposed surfaces makes it appear as though solar radiation is also a causative factor. The etiology of pellagra, however, is nutritional.

Effects of Ultraviolet

The effects of ultraviolet radiation may be accentuated in various ways. The sensitization to sunlight may be increased by the parenteral or per oral administration of such photosensitizing drugs as acriflavine, barbiturates, fluorescin, gold sodium thiosulphate, sulfanilamid and hematoporphyrin. When drugs such as eosin, oil of bergamot, crude coal tar and liquor carbonis detergens are applied to the skin before exposure to either natural or artificial ultraviolet radiations, the effects of such rays may be markedly accentuated. Many cases of berlock dermatitis are caused in this fashion. To prevent this entity, patients should be warned not to use perfume on the skin before exposure to sunlight. This increased effect may be caused by the action of two irritants applied to one area. Of course, those who develop the dermatitis are individuals who are presumably idiosyncratic.

Some persons with desquamating fungeous diseases, such as tinea versicolor (chromophytosis) who expose themselves to ultraviolet radiation, develop a peculiar mottled tan. When the scales are desquamated, the portions beneath them show up as white patches and are in marked contrast to the surrounding tanned skin.

Other diseases which react unfavorably to ultraviolet radiation during certain stages of their evolution are psoriasis, acute and subacute eczema and lupus erythematosus. Some patients with psoriasis when exposed to ultraviolet rays for a time sufficiently long to produce erythema, may develop new psoriatic patches on the erythematous skin which was free of all lesions prior to exposure. Even though heliotherapy is probably the best treatment for psoriasis, nevertheless sufficient care must be used to prevent the spread of the disease. On some occasions ordinary psoriasis may become generalized as a result of overzealous treatment. In fact, even such a serious condition as dermatitis exfoliativa psoriaticum may result from too much ultraviolet radiation.

It is not unusual to see a small patch of acute or subacute eczema become exudative and generalized, following over-exposure to ultraviolet rays. The lesson to be learned from these observations is that this agent must

be used cautiously in the treatment of those diseases that ordinarily respond favorably to heliotherapy. If any unfavorable reactions are noted, ultraviolet irradiation should be discontinued and some other method of treatment instituted. It is advisable to test the sensitivity of each patient with psoriasis or acute eczema before pursuing with full and generalized doses of ultraviolet rays.

The most serious complication in the treatment of dermatoses with ultraviolet radiations occurs in lupus erythematosus. Some patients with the discoid type of lupus erythematosus, who are exposed to ultraviolet rays sufficiently long to produce erythema, may develop a widespread dissemination of the disease. Lupus erythematosus discoides becomes lupus erythematosus disseminatus. In some cases the complication may be even more serious than simple dissemination. The patient may develop toxic systemic symptoms along with cutaneous changes. There may be general malaise, elevation in temperature, joint pains, cardiac and hematological changes. The blood picture may resemble that of agranulocytosis. The now well-known Libman-Sachs syndrome occurs more often than is generally recognized. The ordinary clinical picture of lupus erythematosus may simulate bullous erythema multiforme. It is even possible for some cases of acute disseminate lupus erythematosus to occur after exposure to the sun in individuals who never had any cutaneous lesions of lupus erythematosus. Many cases of acute disseminate lupus erythematosus terminate fatally. With what is now known of the relationship of lupus erythematosus to ultraviolet radiation, it is obvious that this agent is definitely contraindicated in the treatment of this disease. In fact, patients with even mild attacks of lupus erythematosus should not attempt to acquire a sun tan.

A rare disease which usually begins in childhood and is characterized by hyperpigmentation, keratoses, telangiectases and epithelioma formation, and usually terminates fatally is xeroderma pigmentosum. This disease often begins early in life. The earliest lesions seem to follow a sunburn. The skin on the exposed parts of the body such as the face, neck, chest and forearms becomes freckled. Later on in the summer, the lesions become larger by fusion of the smaller areas. Interspersed between them are atrophic spots where the skin is white, shiny and slightly wrinkled. Telangiectases may also be seen on the affected skin. Warty[2] growths of different character occur and these resemble the verrucous lesions seen in the aged. As a rule, these lesions become malignant. Patients also show marked photophobia and lacrimation. Keratitis is common and nodules and opacities occur on the cornea, often obstructing vision to a marked degree. The course of this disease is variable. Most of the children die early in life. A few patients survive to adult years. Some authors are of the opinion that intermarriage may be a predisposing factor; others have noted that the disease is dependent primarily and essentially on inherited susceptibility or predisposition to certain rays of the spectrum. Ormsby[3] states "The influence of light upon the development of the disease in susceptible individuals has been noted by many observers, and the consensus appears to be that the disease is the result of the action of the sun's rays on a peculiarly sensitive skin." The pathologic picture of xeroderma pigmentosum closely resembles senile and sailors' skin and also radiodermatitis.

All these abnormal reactions following exposure to ultraviolet rays have not been fully explained. These undesirable effects vary from simple redness with its accompanying exfoliation and slight pruritus to the production of cutaneous malignancies which often lead to death. The question has often been discussed whether these changes are caused by simple ex-

posures or by a combination of factors, such as chemical and physical changes in the skin brought on by the ultraviolet rays, plus a peculiar idiosyncracy of the individual exposed. Trauma, no doubt, also plays a role. The physiologic, chemical and physical changes in the skin brought on by exposure to ultraviolet radiation are little understood. Further study is required to explain many of the reactions described.

"Tropical Skin" (dermatitis solaris chronica), is the name given by Paul[4] to designate a degenerated condition of the skin caused by overexposure to sunlight. It is characterized by redness, telangiectases, brownish pigmentation (freckles), interspersed with white sclerotic spots, keratoses and epithelioma formation. The serious consequences of this condition and the frequent transformation into cancer have not been sufficiently stressed. The condition is common not only in Australia but in all parts of the world, where people are overly exposed to ultraviolet radiation, either as a result of their occupation or recreation. This condition occurs most commonly on the face, hands and forearms of men in the third and fourth decades of life, engaged in outdoor occupations. Unna has given this condition the name "Seamen's skin" and American dermatologists call it "Farmer's skin."

Irradiation and Cancer

The question whether cancer of the skin can be provoked by exposure to sunlight has been discussed pro and contra for many years. There is no question that now there is sufficient experimental and clinical evidence to indicate that ultraviolet rays are carcinogenic.

Cancer experiments on mice and rats performed by Roffo,[5] Putschar and Holtz,[6] Rusch and Bauman,[7] Findlay,[8] Beard, Boggess and von Haam[9] and others, conclusively prove that malignant tumors (carcinoma and sarcoma) are produced solely by ultraviolet radiation, without the intervention of any other factors. Not only have these tumors been produced by exposure to sunlight, but also by exposure to a quartz mercury vapor lamp. Sunlight cancer experimentally produced may be transferable by implantation to other animals in the same way as tumors produced by tar, x-rays or parasites. In fact, ultraviolet radiation is such an efficient carcinogenic agent that it is now being extensively used in tumor experimentation. Exactly how ultraviolet rays cause cancer to form in animals has never been satisfactorily explained.

In addition to this experimental evidence that ultraviolet radiation is carcinogenic, there is also considerable clinical evidence. Before 1896 Unna[10] noted the more frequent occurrence of cancer on the exposed parts of the body and of the lower lip in fishermen, bargemen, sailors and farmers than in the general population. This clinical observation has been confirmed by many authors.

Paul[4] and Molesworth[11] have frequently written on the occurrence of cancer in the inhabitants of Australia, where a major portion of the population is engaged in outdoor activities. Molesworth states that skin carcinoma in Australia is at least five times as common as it is in Great Britain, where the inhabitants of both regions are of about the same racial stock (fair Nordics). To quote him "The reason for this unenviable prevalence is to be sought in the effect of climatic and industrial conditions." Both of these authors agree that sunlight is the cause of the increased incidence of cancer in Australia.

In a report of 1500 cases of skin carcinomas by Roffo, about 99 per cent appeared on the face and the dorsum of both hands. The prevalence among farmers was greatest, being about 78 per cent. He quotes Hyde,

Hookey and Larabi as having also observed the formation of hyperkeratotic lesions, keratomas and cancer in those exposed to solar radiation. In one of his many articles, Roffo agrees with other authorities that cutaneous cancer is far more frequently seen in races with fair skins than in those with darker complexions; more common in Caucasians than in Negroes; more common in men than in women; and much more frequent in tropical countries than in regions with shorter periods of natural sunlight.

American authors have also observed the frequency of cancer amongst those who are exposed to sunlight for prolonged periods. Broders[12] McCoy[13] and others, have studied cutaneous cancer in patients from agricultural areas. They found that cancer of the skin among farm workers occurred much more frequently than amongst the general population. In a recent article on the etiology of cancer of the eyelids, Sharp[14] states "The second most frequently encountered factor was sunlight and the elements."

Some members of the medical profession and the laity are not sufficiently impressed with the fact that over-indulgence in solar radiation is not totally devoid of danger. The fad of exposing the bodies of children to strong sun for long periods of time over many years and the acquiring by adults of the beautiful bronzing so greatly admired, may lead in later years to ugly, hyperkeratotic, telangiectatic, dry, parched and irregularly pigmented skin on which may later form cancerous growths. Sun bathing is being abused and the good obtained from over-exposure to sunlight is over-estimated by health seekers.

I have discussed the subject of the dangers of ultraviolet radiation in relation to dermatologic conditions, yet I think it is advisable to mention those systematic conditions that may be made worse by the use of heliotherapy. Mayer,[15] Krusen,[16] and Kovács,[17] agree that cases of active and progressive pulmonary tuberculosis may show increase in temperature, loss of weight and fall in blood pressure as a result of exposure to ultraviolet irradiation. Heliotherapy is also contraindicated in hyperthyroidism, diabetes, acute or chronic nephritis, myocarditis, valvular disease and in old cachetic individuals and those that are highly nervous. Mayer also states that ultraviolet light causes a decrease in the bactericidal powers of the blood of experimental animals and hence cautions against the use of this agent in the treatment of acute infectious diseases. However, this does not apply to the direct treatment with ultraviolet rays in infectious processes such as erysipelas, impetigo contagiosa, etc. Ultraviolet conjunctivitis and burns from accidental breakage of quartz and carbon arc burners are other dangers to be avoided.

Summary

1. The bad effects of over-exposure to the rays of the sun vary from simple sunburn to cancer formation.

2. The conditions such as herpes, urticaria, hydroa vacciniformis, xeroderma pigmentosum and their relationship to ultraviolet rays are discussed.

3. Photosensitivity and photosensitizing drugs are mentioned. A complete discussion of the whole problem of photosensitivity is not attempted.

4. The diseases which react unfavorably to ultraviolet rays such as psoriasis, acute eczema and especially lupus erythematosus are described.

5. Experimental and clinical evidence of the carcinogenic action of ultraviolet rays are discussed in some detail.

6. The systemic conditions in which ultraviolet rays are contraindicated are numerated; also incidental dangers to heliotherapy are mentioned.

Conclusion

I want particularly to emphasize the fact that some cases of discoid lupus erythematosus may become so severe following ultraviolet irradiation as to terminate fatally. Also that skin cancer does occur as a result of over-indulgence in solar radiation. The health giving properties of the sun have been over-estimated. The present vogue of exposing infants to the sun in the summer and to sun lamps in the winter for many years, is bound to result harmfully in later years. Also adults who seek the beautiful bronzing of the skin by constantly exposing themselves to the rays of the sun, may develop not only the ugly changes of "Tropical skin," but also cancer of the skin.

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Discussion

Dr. Louis Feldman (Boston, Mass.): I did not understand whether or not Dr. Cipollaro stated in his paper that water-cooled or local ultraviolet was contraindicated in certain dermatologic processes, such as lupus erythematous patches on the face. I also do not know whether or not he said that ultraviolet, local or water-cooled, is contraindicated in local patches of psoriasis. I have two patients now, one with general psoriasis and one with local patches of over ten years' duration who have been under continual treatment. They have been kept well and happy, with no evidence of any type of destruction of the skin on any part of the body, which would indicate a precancerous condition. From my experience of eighteen years in physical therapy, I have not seen a single case of cancer of the skin which could be attributed to non-promiscuous, carefully supervised application of ultraviolet radiation.

Dr. G. J. P. Barger (Washington, D. C.): The substance of Dr. Cipollaro's paper merits reiteration and his zeal in this matter is to be commended. His articles on this subject in the Handbook of Physical Therapy, published by the American Medical Association, should be more widely read. The subject is important also because of the popular zeal for sun tan in summer, because of the zealous advertising of sun lamps for

year-round use, and because of extensive commercial development of many new kinds of light, and particularly in the use of ultraviolet sterilization of water, of food products, of eating utensils, and in operating and hospital rooms for sterilizing the atmosphere, and because in the field of conservation of energy, we want to make the most intelligent use of a vast source of helpful energy.

The lessons learned in Dr. Cipollaro's clinic grow mostly out of mistakes that could not be learned by successes, and we ought to be willing to learn from other people's mistakes; yet too great caution in that respect is unhealthful. In the matter of danger from light sources, Edgar Mayer says, "Happily nature reacts much more favorably to overdosage from light than to overdosage from x-ray. A margin of safety as great as 50 per cent exists, and blistering itself has done little harm." That certain drugs occasionally or commonly used, like sulfanilamide and the barbiturates, may cause our skin to become peculiarly sensitive to light is a matter about which we should be constantly alert. That daily small overdosages of sunlight or ultraviolet light over a period of years can cause considerable damage to human health, is important for us to take account. It is a part of the similar body of knowledge we are recently acquiring that both small excesses and small deficiencies in both useful and harmful products over a period of years can impair our health. Yet human beings, even doctors, are slow to learn, or at least slow to practice the lessons emphasized by specialists in peripheral vascular diseases, by neurologists and by food experts. While there is some danger of overdosage in the use of ultraviolet light, there is today, as we all are well aware, probably a vastly greater danger of underdosage of ultraviolet light to the masses of underprivileged children in our congested cities. But in our efforts to bring them the possible blessings of sunlight and ultraviolet light, we have in Dr. Cipollaro's paper a guide to adopting a sane program.

Dr. Miland E. Knapp (Minneapolis): It is always proper that we should emphasize the dangers as well as the benefits of any type of therapy. Especially is this true when that therapeutic agent enjoys the widespread popularity, the universal availability and the tendency toward use without supervision or restriction that is afforded by ultraviolet radiations. We must always bear in mind the self-evident truth that every effective therapy is also dangerous therapy. The mere fact that an agent is able to influence or change physiologic or pathologic processes is evidence enough that overdosage is to be avoided.

Dr. Cipollaro has covered the field rather exhaustively. However, I would like to emphasize two points which he mentioned, but upon which he did not elaborate. The first is the apparent antagonism between sulfanilamide and ultraviolet. Since the employment of this drug in the treatment of every infection has become a national practice in the past few years, it is especially fitting that a word of warning be sounded in this regard. It is well known that some individuals are made hypersensitive to sunlight by the administration of this drug. It is not as well known that animal experimentation has indicated that these two agents may be directly antagonistic in some manner, so the employment of both sulfanilamide and ultraviolet in the same patient may eventuate in poorer therapeutic results than would be expected from either agent if used alone.

Dr. Pincussen and Dr. Nedzel presented a paper before this Congress last year which clearly indicated such an effect. Therefore, I believe that ultraviolet irradiation should not be applied if sulfanilamide has been used previously, or at least, the ultraviolet should be used with extreme caution if its employment is deemed absolutely necessary.

The second point I would like to emphasize is that overdosage of ultraviolet radiation can occur from the cumulative effect of many small doses as well as from massive single doses. Dr. Pincussen yesterday showed that short, intermittent doses were more effective than long, continuous irradiation in the destruction of streptococci by ultraviolet irradiation. It has been my custom to give tonic ultraviolet in courses lasting no longer than two months, and then to allow a rest period in order to minimize the likelihood of overdosage from this cumulative effect and the probability of untoward results, so that the condition known as farmer's skin, may be considerably diminished.

Dr. William T. Anderson, Jr. (Newark, N. J.): Dr. Cipollaro's paper contains very little that a physicist can discuss. He makes no reference to the quantities of radiant energy required for the attainment of the results which he describes. He attributes them to the ultraviolet radiations in sunshine, but he does not offer any evidence that ultraviolet radiations are responsible for these results.

Sunshine and the radiations from lamps consist of a heterogeneous mixture of wavelengths. These are scattered through what is known as the ultraviolet, visible and infrared spectra. Which of these radiations are effective in a particular biochemical or clinical reaction can be determined only after careful experiments have been made in which definite portions of the spectrum have been included or excluded.

A few photo-biologic reactions have been carefully studied and the portions of the spectrum and the energies required have been carefully determined. The erythema raction is one of these. Dr. Cipolllaro is entirely correct in attributing the erythema reaction to the ultraviolet.

I do not know of any substantial evidence which indicates what part, if any, radiations exercise in the production of those conditions known as tropical skin, seamen's skin, and farmer's skin. Many papers on the subject attribute the condition to sunlight and some authors believe it due to the ultraviolet component of sunshine. Opinions can hardly be considered scientific evidence.

A number of animal experiments involving nocturnal animals such as white rats and white mice have been described in the literature. The experimenters have employed heterogeneous radiations in quantities greatly in excess of what man could tolerate. The animals either died or developed tumors before they died. What part, if any, ultraviolet contributes to this, I am not aware. The answer to this question will be known only after some capable investigator repeats the experiments with selected portions of the spectrum and known energy quantities.

Dr. Cipollaro makes reference to Dr. Beard's work. It is interesting to note that Dr. Beard says:

> Since the normal habitat of the rat is darkness, it is to be expected that this animal would be more sensitive to the ultraviolet rays than would man. It required on the average about seven months of continuous irradiation to produce cancerous changes in the rat, which would be equivalent to twenty hours daily ultraviolet irradiation for about eighteen years in the case of man.

I get the impression that Dr. Cipollaro's paper is concerned primarily with very excessive irradiation and over-exposure. I do not believe that he recommends the abolition of parks, beaches and other out-of-door recreational centers where mankind enjoys the fresh air and sunshine. Ultraviolet radiations in moderation are certainly no more dangerous than are air and water.

There are, of course, some unfortunates who are supersensitive to sunshine and various other forms of medication. These, knowing their idiosyncrasy, should take the necessary prescribed precautions. Dr. Cipollaro gives a timely warning to these people.

Dr. Richard Kovács (New York): I want to agree with what Dr. Feldman said. It was my experience in a recent case of lupus erythematosus that the patient came for ultraviolet treatment because he claimed that similar patches on his nose had cleared up with ultraviolet exposure. I explained to him that there might be possible danger, so we exposed one side very carefully to ultraviolet. The patient came back delighted a week later because the condition had cleared up.

I went on my vacation then, and I sent him to a dermatologist. He threw up his hands in horror because he said I should never have used the ultraviolet lamp on it. However, seeing the improvement to one side, he continued and gave the ultraviolet exposure to the other side, locally, and when I came back from my vacation he reported that the dermatitis had entirely cleared up under these treatments. He concluded that this may not have been lupus erythematosus, but that it looked very much like it.

Dr. A. C. Cipollaro (closing): Let us first discuss the practical questions of lupus erythematosus and psoriasis. Dr. MacKee and I have adequately described the treatment of lupus erythematosus with ultraviolet rays in Principles and Practice of Physical Therapy, Chapter 4, page 94, volume 3, published by Prior & Co., and also in the Handbook of Physical Therapy, page 341, published by the American Medical Association. Ultraviolet rays from the water-cooled lamp in destructive doses are indicated in cases of discoid lupus erythematosus. Treatment with solid carbon dioxide is also indicated in this form of the disease. These methods may be used alone or in conjunction with others. It must be emphasized again that generalized ultraviolet irradiation is contraindicated in all forms of lupus erythematosus.

With respect to psoriasis, I would like to reiterate that ultraviolet rays are not contraindicated. However, doses sufficiently large to produce erythema may cause the precipitation of patches of psoriasis in the erythematous areas. Therefore when psoriasis is treated with ultraviolet rays, great caution must be exercised. Generalized treatments should not be of such intensity as to produce exfoliation and vesiculation. I do not want to convey the impression that ultraviolet radiation is contraindicated in the treatment of all cases of psoriasis; it is not.

I would like to agree with all the remarks made by Dr. Knapp with regard to sulfanilamide. I simply mentioned the photosensitizing drugs. Time was insufficient to discuss any of the details of the relationship of ultraviolet rays to photosensitizing drugs.

I tried to point out that the clinical experiences of authorities from different parts of the world clearly indicate that prolonged exposures to ultraviolet rays can produce cancer in animals. Also there is clinical evidence to support the laboratory findings. Therefore one must conclude that ultraviolet rays under certain conditions are carcinogenic. There is no established proof as to which portion of the ultraviolet ray spectrum is responsible for these carcinogenic changes. There is evidence that both natural sunlight and the hot quartz mercury vapor lamp can produce cancer in animals. In fact, some laboratories engaged in cancer research use ultraviolet rays as the carcinogenic agent in place of tar or other irritants that were formerly so popular.

A final word in closing: Use ultraviolet rays for therapeutic purposes with reason and judgment in conditions in which this agent is indicated. The abuse of this most valuable agent may lead to disastrous results.

SYNERGISTIC EFFECT OF DRUGS AND LIGHT ON STREPTOCOCCI *

LUDWIG PINCUSSEN, M.D., Ph.D.

and

A. J. NEDZEL, M.D.

CHICAGO

The effect of sun rays on living organisms is seldom immediate, since in all cases the reactions following the absorption of the energy are secondary or even tertiary. In higher animals the chain of events initiated by the irradiation is a very complex one, and the effects on mice inoculated with streptococci or through intake of certain drugs seem to be due to changes in the general metabolism of the animal.[1] In contrast to this obviously complicated system the effect of the rays on the same microorganism in vitro may be easier to explain. It is interpreted from a physico-chemical viewpoint in the sense of changes in colloidal behavior, coagulation and other conditions which may be associated with the lethal action on the bacteria.

In this paper we present some observations concerning the effect of the sun's rays upon streptococcus haemolyticus cultures grown on standard blood agar plates. The strain used for these experiments was isolated from a case of mastoiditis by I. Pilot of our Medical Department.

It has been known for many years that only ultraviolet rays show a marked effect upon bacteria in vitro.[2] This was again confirmed by our experiments, which showed that the effect of visible rays on at least twenty-four hour cultures is a very poor one. Exposing the colonies to a total of 600 microcalories (this is about a 20 inch distance from the light source) per cm. square minute, we did not get any visible effect with E and SS carbons in the carbon arc lamp, even if the irradiation was maintained two hours. With the C carbons the effect was more pronounced, probably due to the rich emission of ultraviolet rays; but even then more than four times as many calories were needed than if the same amount was given by the high pressure mercury-in-quartz arc.

Irrespective of the proportional content of ultraviolet energy, the total applied irradiation being about the same in these two sources, it seems that other factors which are not to be discussed here, may be involved, among which probably the wavelengths in the spectra are to be considered of some importance.

Spraying the cultures before irradiation with a saturated solution of sulfanilamide did not alter this reaction. It required about the same time to sterilize twenty-four hour old streptococci cultures with and without this drug. This substantiates the previous observations that sulfanilamide has no direct action upon streptococci and that the cooperation of the forces in the body is needed for the effect produced by this compound.

Since the application of visible rays even when mixed with some ultraviolet did not seem effective in destroying these cultures, we endeavored to ascertain the action of ultraviolet emitted by the hot quartz generator. On the assumption that cultures of varying ages may show different suscepti-

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bility to the light, we utilized also cultures of three and six hours and immediately after inoculation.

The results shown in figure 1 apparently indicate that the younger the cultures (the shorter the time between inoculation and irradiation) the less time is needed for killing the microorganisms. Using the same quartz lamp at a constant distance (whole energy 600 microcalories per cm. square minute), more than twenty minutes were needed for sterilizing the twenty-four hour cultures and less than one minute for inhibiting the growth of a just inoculated culture. For three and six hour old colonies the time needed for sterilization was between two and three minutes. Thus it becomes obvious that the fresher the infection the better the chances for fighting it by the action of the rays.

The effect of the irradiation in many cases is not restricted to the duration of the exposure, but is maintained for some time. This is due partly to the so-called "after-effect" to be explained by the theory of chain formation,[3] or that of a catalyst.[4] Thus the sterilizing effect produced by the rays may be increased by scattered or rather interrupted irradiation. Experimenting with interrupted irradiation upon streptococci cultures we were able to secure the same phenomenon, as shown by the broken line in figure 1. By irradiating one minute, discontinuing two minutes and resuming again one minute, the effect was obviously superior to that produced by two minutes of continuous exposure. Where more than twenty minutes continued irradiation was needed, twelve minutes of intermittent irradiation sufficed to produce the same effect. By better arrangement of the periods of irradiation and intermission we may find that it will require a still shorter time to obtain the same effect.

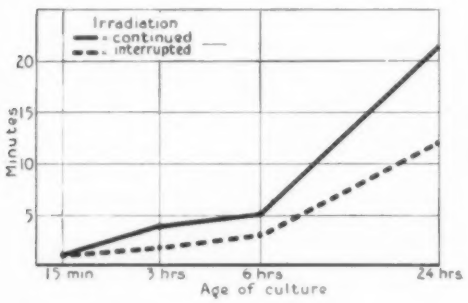

Fig. 1. — Time needed for sterilizing cultures of Streptococcus haemolyticus by continued and interrupted ultraviolet irradiation.

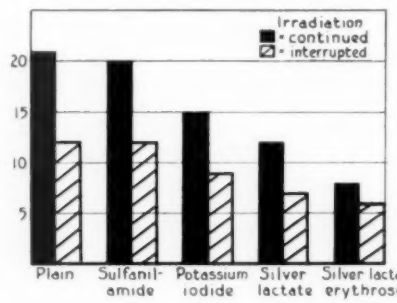

Fig. 2. — Time needed for sterilizing 24-hour old Streptococcus haemolyticus cultures by combined action of ultraviolet and drugs.

Effect of Radiation and Drugs

Concerning the combined effect of drugs and rays upon bacteria, we may expect that the action will be enhanced provided bactericidal substances can be created from the drug by irradiation. This may open an additional method of attack on microorganisms. There are two molecules very important for bactericidal action, silver and iodine, and it is to be assumed that their effect will be still stronger in the nascent state. The photochemical action of iodine from iodides on organisms has already been demonstrated by Pincussen.[5] The role of silver in the presence of actinic rays is a familiar one. The formation of molecules from silver compounds by light is generally known as the basis of the photographic process,[6] but sensitizing dye stuffs to increase the speed of this action is a recent observation of value to clinicians.

The twenty-four hour old cultures were sprayed with a one per cent solution of potassium iodide or silver lactate before being exposed to the rays. Some of the experiments were performed with continuous, others with intermittent irradiation. In figure *2* the black columns show the time needed for sterilization by continuous irradiation, and the striped columns the time required with intermittent application. The results demonstrated in figure 1 with irradiation of pure ultraviolet are shown also in figure *2* for comparison with the effects obtained when the cultures had been sprayed with the aqueous solution. Spraying with sulfanilamide did not alter the effect whether continuous or interrupted irradiation was used.

The result was strikingly modified after the cultures were sprayed with solutions of potassium iodide or silver lactate with and without the addition of sensitizing erythrosin. The time required for sterilization was substantially decreased, the decrease being greatest when intermittent irradiation was introduced. The two methods outlined above tend to produce this strong effect, and it may not be unlikely that further investigation will show that it is possible to enhance the action even more by scattering the irradiation in a manner different from the technic just described. At the present time two technics to increase the action of rays on bacteria are: (1) scattering the irradiation, that is, delivering a dosage in the form of several divided "shots," and (*2*) using as a spray certain drugs which form highly bactericidal agents under the influence of the irradiation, such as atomic silver and iodine. The findings suggest a new approach in the use of ultraviolet, because it demonstrates that the effect of irradiation may be enhanced three and even more times.

Since it was found that young cultures are extremely susceptible as compared with old ones, it is not at all improbable that we may be able to control to a high degree of certainty the acute infections and the carriers of microorganisms, problems of importance to public health. It suggests itself at least theoretically, that if infected cavities or other accessible regions should be sprayed with the above stated drugs and then subjected to interrupted irradiation, the therapeutic results may prove a valuable addition to accepted methods of treatment.

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Discussion

Dr. Fred B. Moor (Los Angeles): The bactericidal action of ultraviolet radiation depends upon a number of factors apart from the direct lethal action of the rays. The essayists have discussed the influence of the age of the culture. Other factors are the hydrogen ion concentration and turbidity of the medium, the presence or absence of moisture, the bacterial food supply, and whether or not the organism is a spore bearer. Doubtless the authors have controlled these various factors.

Dr. Pincussen's study is especially interesting in that it presents a combination of pharmacology and physical therapy. The liberation of active elemental ions by physical means is a field which deserves extensive exploration. We have been particularly interested in galvanic iontophoresis of metallic and alkaloidal ions for local bactericidal and vasomotor effects. The galvanic current not only frees the therapeutic ions but causes a certain amount of penetration of these ions into the skin. Bactericidal effects, vasoconstriction or vasodilatation can be produced at will. Penetration is of importance in the treatment of fungus infections which extend

below the skin surface. This is illustrated by the successful treatment of epidermophytosis by iontophoresis of silver as recommended by Harpuder, or of copper as recommended by Haggard, Strauss and Greenberg. We have observed the successful treatment of this disease by painting the infected area with 20 per cent silver nitrate and then irradiating with the water-cooled mercury vapor quartz lamp.

The application of ultraviolet alone for local infections is sometimes disappointing. Therefore, we should welcome this presentation which brings to our attention an improved technic.

Dr. O. Leonard Huddleston (Denver): I am especially interested in Dr. Pincussen's paper because I think it indicates a trend in therapeutics which we will see more of in the near future, namely, a combination of chemotherapy and the use of physical agents. We are just beginning to learn a little about the relationship of drugs to physical agents, and to utilize it clinically. We all are familiar with the combined use of sulfanilamide and fever therapy; now we have been told about the combination of ultraviolet and various types of drugs. Our knowledge at present is rather meager, and since some of these combined treatments seem to be very beneficial, it would be worth-while to thoroughly investigate these procedures, both from the clinical — that is, in clinical experimentation — and from the laboratory points of view. If this branch of physical therapy is to continue to progress as it has done, it is necessary to do a tremendous amount of experimental work to put it on a rational, scientific basis, to render it more than simple empiricism.

Dr. M. J. Dorcas (Cleveland): In other chemical, physical and mechanical fields, the use of light in conjunction with material substances to accomplish specific ends has progressed to a considerable extent. I think in particular at this moment of the color sensitized silver emulsions in the photographic field and of the use of sensitized bacteria in the sterilization of water. The experiments just reported by Dr. Pincussen, though not of a clinical nature, promise, it seems to me, reasonably early applications if they are extended on a clinical basis. These experiments offer a scientific background from which theories may be deduced, and tests and applications made clinically.

The essayist has measured his reagents, and approaches the problem in a scientific fashion. A small extension of the experiments, reduced to a set of principles, would be sufficient so that intelligent application can be made. This subject of scattered radiation, or, as I might call it, intermittent radiation, as applied to the death of bacteria is to me not a particularly new one. There are two precedents for that which are not directly like the essayist's, but other experiments that indicate a definite effective time relation of the exposure. In a photochemical process of producing vitamin D from the provitamin in milk, it has been found that the continuity, or intermittent nature of the radiation, has a pronounced effect on the efficiency of the process. In the photochemical chlorination or halogenation of certain organic substances, somewhat similar to this photochemical decomposition of potassium iodide, it has been found that an intermittent exposure to light will sometimes cause a change in the net direction of the reaction because it permits the chain of reaction to proceed with less interference from the side reactions or the opposing photochemical reactions.

Although these experiments are not clinically applicable in their present form, I was interested in them and hope that we will see them continually expanded to a larger scale, because I believe they are but a step away from important clinical applications.

Dr. William T. Anderson, Jr. (Newark, N. J.): The killing of bacteria by radiations is a subject of major importance. There exists an extensive literature on the subject, but much further research is required before we will have a complete knowledge and understanding of the subject. Our knowledge today appears to indicate that the lethal action by radiations results either from direct biochemical changes produced within the bacterium itself, or indirectly by the production of peroxides, photochemical oxidations and substances toxic to bacteria in the medium supporting them.

The direct action requires that sufficient radiation of effective wavelength and adequate intensity reach the individual bacterium for greater than the minimal time. The most effective wavelengths appear to be in the ultraviolet spectrum between 2500 and 2800 Angstroms.

The direct action of ultraviolet upon bacteria has been utilized for many years in the sterilization of water for bottling plants, lake steamers, lumber camps and the like. More recently it has become known that bacteria suspended in the air are important causes of cross-infections in children's hospitals, infections from operations, and food spoilage. These air-borne bacteria are killed very rapidly by ultraviolet radiations, and it has been found entirely practical by means of suitable generators to reduce the bacterial content of the air in a room so that the possibility of infection is greatly minimized.

The application of drugs plus irradiation for the killing of bacteria in a host is a virgin field for research. There have been unsubstantiated reports that the lethal action of sulfanilamide and of quinine is enhanced if shortly after the administration of the drug the subject be irradiated. In the case of sulfanilamide, the irradiation results in a temporary blue pigmentation of the skin. As far as I am aware, no one has as yet disclosed the chemical nature of this blue pigment and what part, if any, it plays in the reputed enhanced lethal action.

Dr. Pincussen and Dr. Nedzel appear to have confirmed that there is an enhancement resulting from the irradiation after application of sulfanilamide, the hosts being mice. It is hoped that they will continue their work which gives such excellent promise of leading to practical means for the control of infections.

Dr. Ludwig Pincussen (closing): We have in mind to bring this problem to a conclusion; not to leave it on a theoretical scale, but to develop it farther for use in therapy, because, as I have said, we hope to help public health through the sterilization of bacteria carriers, and the like.

I want to thank Dr. Dorcas for his expression of "intermittent" irradiation. I think that term is much better than "scattered" radiation. In reply to Dr. Anderson's discussion, I want to say that there is much that is known about irradiation of living material — that moisture plays an important role, for instance, and heredity — but we cannot take those into consideration at this time. When we conduct our experiments we try to keep the same conditions everywhere, and the results I gave were obtained with cultures made in the same way. Of course, as in every other experiment, we must relate our findings to a certain type. In this instance, it was the culture, the standard agar plates of the streptococcus, and on this we got definite results. I know it is not the only thing that can be done, but there are many problems involved which could not be presented at this time.

REMOVAL OF SKIN GROWTHS AND BLEMISHES BY ELECTRIC NEEDLE

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MONONGAHELA, PENNSYLVANIA

The medical profession recognizes that a facial defect or blemish will affect a woman's spirit and health and give her an unhappy complex. The longing for beauty may warp her entire life. The presence of a wart, mole or birthmark on the face, neck or arms may cause the loss of mental poise. She becomes reticent and avoids public appearances. But it isn't as generally realized that a man with a facial defect or blemish will suffer from an inferiority complex quite as much as a woman.

It is not my intention to dwell on the technic of the different methods used in the removal of skin growths and blemishes, or attempt to add to the knowledge of other men who specialize in diseases of the skin. The purpose of this discussion is to bring to the attention of the profession some conditions that have been found to respond well to electrosurgery.

Electrosurgery of the skin has great value if performed by one who is skilled in the technic, and who thoroughly understands the complications and limitations as well as the usefulness of the method. The pre-requisite to good results is the establishment of correct diagnosis, the judicious choice of the modality and its intelligent application. Good judgment must be exercised in selecting the treatment best suited for each individual growth.

The advantages of the electric needle in removing new growths and blemishes are:

1. Painless method.
2. Accuracy of control — easily limited to abnormal tissues.
3. No dressing or after treatment necessary.
4. Better cosmetic results.
4. No loss of blood.
6. No post-operative pain.
7. Less chance of post-operative infection.
8. Less chance of metastasis.

9. Quick method — usually but one treatment required.
10. Healing more rapid.

In removal of skin growths and blemishes by the electric needle it is important to recognize the cancer or malignant tendencies of new growths and blemishes.

Bluish-black moles and the yellow-reddish warty outgrowths in elderly patients have great malignant potentialities. These tend to become ulcerated and later covered with crusts. One should not think that a wart, mole or nevus is harmless just because it has been present since birth. They may take on cancer tendencies any time. When they do, usually there is a history of their being frequently picked, rubbed, cut or injured, or caustics or acids applied, or other poor attempts at their removal before cancer becomes evident.

In benign cases the object is to destroy no more than the lesion itself in order to obtain the best cosmetic result.

Pre-cancerous lesions should be destroyed completely with one treatment without regard for cosmetic results. It is dangerous not to destroy the lesion completely in one treatment and this can hardly be done by caustics or acids, carbon dioxide snow, excision, or any treatment that requires more than one treatment. The indiscriminating use of acids and caustics to remove growths and blemishes is to be condemned. It is an inferior method as it requires a number of treatments that are painful and difficult to confine to the destruction of tissues of the lesion proper. Also the cosmetic results are frequently bad. Surgical excision is usually undesirable since the cosmetic results are inferior. Removal by cautery is not satisfactory as the action is chiefly superficial. The healing is delayed as the tissue is burned, and the resultant scars are unsatisfactory.

Experience shows that the best available method is the use of the electric needle in the hands of an experienced, skillful operator. Improper treatment by inferior methods often aggravates the condition, and not infrequently benign lesions become cancerous. If there is any suggestion of beginning cancer it is always wise after destroying the lesion with the needle to follow up with x-ray irradiation.

It is always proper when using the electric needle routinely to work around the periphery of a growth and beneath it, first, before attempting to destroy the body of the growth itself. This seals off the blood vessels and lymphatic channels in the path of the current. This precaution is important in eliminating most of the danger of disseminating cancer cells from the primary growth. After the body of the growth is dehydrated and shrunk, it is scraped off with a curet and the raw surface is again treated with the spark to destroy any cancer cells that may have been missed when the body of the growth was treated.

Methods

Electrodesiccation is accomplished by a current of high voltage and low amperage. This monoterminal high frequency current develops only a moderate degree of heat in the tissues causing a superficial destruction of the growth or blemish. Its effect on the tissue is desiccation, dehydration or mummification. A reaction is scarcely noticeable and the resultant scars are perfect. The needle is not inserted into the growth, but only close to it, to permit arcing of a spark.

Electrocoagulation requires a current of low voltage and high amperage. This biterminal high frequency current causes a deeper destruction of tissues.

The growth is attacked by inserting a pointed needle electrode into the growth and having a large indifferent electrode on some other part of the body. The right amount of current is turned on only for a second or two to cause destruction by coagulation of the tissues in the vicinity of the needle. This coagulation is caused by heat generated in the tissues by their resistance to the current. Smooth and non-contracting scars are left, not easily discernible from the rest of the skin. This method is used in angioma cavernosum, nevus pigmentosus, nevus pilosus, large nevus lipomatodes, and epitheliomas. The latter is followed with x-irradiation.

Electrolysis is obtained by a galvanic current. It is a valuable method chiefly for removal of non-malignant lesions and it is the best method available for permanent destruction of superfluous hair. In this latter condition a fine needle held in a special holder is gently inserted along the side of the shaft of the coarse hair down to the papilla. The needle is then connected to the negative pole. The patient holds a moistened electrode connected to the positive pole to complete the circuit. The current is turned on to a few milliamperes, and after a few seconds a frothing occurs at the mouth of the follicle. The current is then turned off, the needle withdrawn and the hair is pulled out easily as the papilla has been destroyed. Of course, this method is not applicable to the removal of lanugo.

One should never use x-rays to remove hair because cosmetic damage may result as it is impossible to effect destruction of the papillae without producing degenerative changes in the skin. Patients should be warned that the only safe measure for the removal of superfluous hair is electrolysis. This method can also be used in nevus araneus, nevus pilosus, nevus verrucosus, non-elevated nevi, hairy nevi, and the dilated capillaries of acne rosacea.

Indications

Plantar warts and callous formations on the soles of the feet are very painful. They are readily removed by the needle in one sitting, leaving a flat open wound. The pain upon walking is immediately relieved. The discomfort of the clean wound until it heals is much less than the pain caused by walking upon the callous or wart. The results are excellent.

Verucca barbae of pinhead or larger size on the face and neck are quite a problem to the victims who have to shave. These are readily removed by desiccation. Several treatments are necessary to take care of new growths that are in the stage of development.

The desiccating current is the method par excellence for removal of all kinds of warts and smaller growths. It is the best method of removing the spider nevus — a central red spot from which blood vessels radiate like the spokes of a wheel. It is also the method of choice in correcting telangiectasis, senile and cavernous angiomas. The same current is used in senile seborrheic keratosis, but in this condition it is well to follow routinely with x-irradiation. Cutaneous horns respond well to one treatment. Xanthelasma is removed quickly and effectively. Desiccation is also used for the red elevated nevi (nevus vasculosus), small lipomatodes, mulberry nevus, lupus vulgaris, luby spots, molluscum contagiosum, flat pigmented moles, port wine mark or naevus flammenus, and new growths on the eyelids.

The hairy nevi are treated first by the galvanic needle to destroy the hair papillae; then the nevi proper are destroyed by desiccation.

Conclusion

The electric needle treatment is the most efficient method of removing skin growths and blemishes.

It should be recommended by the profession not only because of its life-saving effects in the removal of potential or pre-cancerous lesions, but also because the treatment is painless and excellent cosmetic results are obtainable, in addition to the incalculable psychic effect on the patient.

Water Excretion — Bessemans, *Et Al.*

(Continued from page 222)

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ARCHIVES of PHYSICAL THERAPY
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.·. EDITORIALS .·.

THE AMERICAN MEDICAL ASSOCIATION AND EDUCATION IN PHYSICAL THERAPY

In a recent issue of *The Journal of the American Medical Association* appeared one of the most pregnant and constructive criticisms leveled at the present trends in medicine, which points out the deficiencies, needs and opportunities in physical therapy in relation to its instruction and practice in American Medicine. This article should, and no doubt will, have far reaching influence in arousing the interest of every serious minded and progressive individual toward means of providing educational facilities for our present and next generations of practitioners on a par with that of other branches of medicine. In its searching analysis of this vital problem, the American Medical Association through its special forum (The Thirty-Sixth Annual Congress on Medical Education and Licensure) and its columns, obviously support the critical analysis of Gregg[1] of the Rockefeller Institute, in his courageous challenge against those contemporary traditions in medical instruction and practice which apparently are so defective as to require radical revision or modification. His inventory of what is commonly lacking and insufficient in the great majority of our class A medical institutions so keenly isolates the weak and inadequate parts of their curricula that its unconscious iconoclasm promises to arouse a profession long in genuflection to the practices of yesterday to a realization of pressing opportunities of today and tomorrow. The order of the World is change in the direction of progression or retrogression, and there is today definite need for a teaching program that is based on vision along the lines of "social, financial, professional and administrative milieus in which it exists."

The problem in medicine as pointed out by Gregg is not to concentrate all efforts on merely holding the advantages gained or acquired in the past thirty years, but to expand our opportunities by a program of courageous foresight that will include the decade ahead of us. It is therefore a hopeful sign that among the criticisms leveled against organized medical education, one of the most detailed and constructive pleas for greater recognition by medical schools concerns the problem of physical therapy. Next to pharmacology which today is billeted in the scheme of clinical medicine somewhat like the latest roomer in an already overcrowded house, physical therapy to paraphrase Gregg, occupies the strange position of the unpleasing relative whose occupancy is resented by a none too tolerant household. Out of politeness or because of certain needs it is encysted to a division of minor importance and articulated to a major branch whose influence reduces its role to that of an inarticulate satellite. Under such treatment it is not strange that physical therapy like pharmacology exhibits a state similar to the neurosis seen in laboratory animals — "a strange confusion of fear and friendliness, impetuousness and inhibition, dependence and false pride in its relations with even the best commercial people, who on their side could contribute much of value if the circumstances were less confused."[2] No more eloquent indictment against our teaching universities and our profession has been uttered in recent times with reference to the apathy and so-called con-

servatism extant in these two groups than that expressed by Gregg. Because of its timeliness and trenchant frankness we quote in detail:

> A curious phenomenon in American medicine is the deft elimination of much reference to physical therapy. Almost as those who keep their children ignorant of the facts of life, we appear to protect the American medical student from the knowledge of physical therapy, mindful, I suppose, of the abuses imputed to osteopaths and chiropractors. Of course, there is much the same result: thus protected, our graduates angrily complain of competition from those whose knowledge it is tabu to acquire. Cornford comments on propaganda as the art of lying in such a way that you very nearly deceive your friends without quite deceiving your enemies. That reminds me of the way physical therapy is propagated in this country. But the effects of heat on capillary circulation, lymph flow and inflammation, and the indications and effects of massage and passive movement or of irradiation, can certainly be learned and taught as physiology without any trace of charlatanry. The current unabashed ignorance of physical therapy in this country leaves it as an excellent opportunity for development in American medicine.
>
> Of course, a much more inclusive and significant development, in which physical therapy would be but a small part, would be the recognition of biophysics on a basis similar to that of biochemistry. True, it would belong close to physiology and at first it would derive from physiology as did biochemistry. Indeed at the present time the application of methods of electrical stimulation, record and measurement dominates the research interests of so many American physiologists that biophysics removed from physiology would leave something of a vacuole. As in most of the preceding suggestions, I argue here for the explicit acknowledgment of insidious reality: physics is applied to medicine, physics is required for entrance to medical school, and yet deliberate recognition or energetic development of the potentialities of biophysics is left as the responsibility of no one in particular, leading a grant-in-aid existence until its value as a companion piece of biochemistry is finally admitted.

Undoubtedly education in physical medicine in America — diagnostics and therapeutics — owes its greatest impetus to the interest and progressive stand taken in its behalf by the American Medical Association. Its authoritative voice and far reaching influence have been the stimulus and inspiration for the revival of this discipline in most of our medical centers, and the means for the growing consciousness in the profession of its value. Not unmixed with this appreciation by those of its members and that of our Congress is their sad reflection that such initiatives in education and practice instead of being fostered and encouraged by the teaching forces of medical centers where knowledge and its promulgation is a prerogative of its heritage, are brought or forced to their attention by the voice of an organized profession. Again, the situation is not unmixed with a certain amount of pessimism because it becomes clear that the isolated voice and the limited scope of any but the largest organization and publication, must depend upon time and the tedious process of slow education to carry any of their vital messages to those whose influence carries greatest weight. In its scientific deliberations the Congress has in the past taken the same stand as Gregg. As early as in 1928, Kobak[3,4] presented a plan of education that incorporated lectures on the biophysical interpretations of the human organism in relation to the energy in our environment, the relationship and significance of the physical forces utilized in medicine and their physiologic response, and the application of these studies to clinical purposes. That twelve years have elapsed before an independent source under the aegis of the American Medical Association expressed similar thoughts and voiced great concern regarding the apathy of the educational forces is reason for hope and assurance that the future of physical therapy is as secure as the foundation upon which it rests.

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SOUTHEASTERN SECTION OF CONGRESS TO MEET AT ATLANTA

The Southeastern Section of the American Congress of Physical Therapy will hold its Spring session on May 20 and 21 at the Atlanta Biltmore Hotel, Atlanta, Georgia. The officers of this section, especially its zealous secretary, have left nothing undone to render this gathering of two full days as interesting as it will prove profitable. The program is published elsewhere in this issue of the ARCHIVES. It provides properly arranged material, so that the first day will be devoted to instruction of theory and technics of fundamental problems in Physical Medicine and the second day to scientific presentations with particular reference to every-day clinical needs. The evenings will be filled by distinguished guest speakers, with the last evening to be preceded by a section dinner.

The program proper is varied in nature in that it takes up advances in short wave diathermy, the management of arthritis and of poliomyelitis, problems pertaining to the production of artificial fever, and like interesting and informative topics. Atlanta is justly called the Athens of America, for apart from its many urban attractions the city is located in a scenic environment that leaves a pleasant memory never to fade for all visitors to the city and its environs. During the month of May the foliage is most beautiful and the climate ideal, so that all physicians and vouched-for technicians who will attend the section meeting will not only benefit in a professional sense but obtain one of the most enjoyable vacations, brief though it may be.

Among the distinguished speakers during the various sessions, Dr. Elkins, of Rochester, Minn., will give two addresses, one dealing with light therapy and the other with high frequency currents. Dr. Currence, of New York, will discuss active and passive exercise combined with hydrotherapy and present the dinner session with an address dealing with important phases of the arthritis problem. Short wave therapy from a purely clinical point of view is the subject of Dr. Zeiter, of Cleveland, at the same evening session. Hyperpyrexia in relation to general hospitals is a subject to be presented by Dr. Holbrook, of Statesville, N. C., while our Vice-President Polmer will give two papers, one on electrodiagnosis and the other on physical measures used in the management of fractures. Dr. Bagwell, of Knoxville, Tenn., will extend the theme of physical therapy to the field of orthopedics. Dr. Chance, of Cumberland Gap, Tenn., will take up the ever important subject of galvanotherapy and the use of wave currents. Nasal ionization is a topic that will be given careful consideration by Dr. Blassingame, of Memphis, while problems of colon therapy will be critically discussed by Dr. Cline of Miami, Florida.

The officers of the section extend their most cordial invitation to all members of the medical profession as well as to those of the Congress to attend the coming meeting. It is earnestly suggested that those who intend to participate in this SEMINAR or who desire especial information should communicate at their earliest convenience with the Secretary of the Section, Dr. Kenneth Phillips, 1150 S.W. 22nd Street, Miami, Florida.

SCIENCE, NEWS, COMMENTS

Meeting of Pennsylvania Physical Therapy Association

The Pennsylvania Physical Therapy Association will hold a meeting in Allentown, Pennsylvania, at 2:30 P.M., Tuesday, May 14, 1940, at the Sacred Heart Hospital. The following splendid program will be presented:

1. Physical Therapy with Skin Traction and Manipulation, *Dr. W. J. Schatz;*
2. Histamine Iontophoresis as Used in Arthritic States, *Dr. U. D. Rumbaugh;*
3. Use and Application of Desiccating Current, *Dr. William Schmidt;*
4. Use of Rapid Sine Current in Neuralgias, *Dr. B. Ulanski;*
5. Diathermy, as Used in Cerebral Morbidities, *Dr. A. A. Martucci.*

There also will be an evening session, to open at 8:30 P.M., at which the guest speaker, *Dr. Norman E. Titus* of New York City, will address the Association on Short Wave Diathermy. Following this paper there will be shown a moving picture by *Dr. W. J. Schatz* on Multiple Sclerosis.

Dr. Richard Kovács Addresses Medical Groups

Dr. Richard Kovács of New York spoke on "Electricity in Medicine" before Duke University Medical School, Durham, N. C., on Saturday, March 30th; on "Physical Therapy in the Present Day Practice of Medicine" before the Jefferson County Medical Society at Birmingham, Ala., on Monday, April 1st; and on "Spas and Health Resorts in the United States and Abroad" before a joint meeting of the Greenbrier Valley Medical Society of West Virginia and the Bath-Alleghany County Medical Society of Virginia at White Sulphur Springs, W. Va., on Saturday, April 6th.

Cancer Conquest May Be Triumph of Machine Age

Cancer, Number Two Killer of mankind, may be mowed down by the mechanical developments of the machine age we are now living in. This picture of the conquest of cancer being added to the annihilation of time and space by man-made machines appears in a review of latest cancer developments announced by the American Society for the Control of Cancer.

The two latest developments in treatment of cancer patients are neutron rays from one of the hugest of machines, the cyclotron, and the refrigeration treatment in which air-conditioning machines are now used to maintain the low temperatures. The verdict of the American Society for the Control of Cancer on the refrigeration or frozen sleep treatment is that cancer pain is temporarily alleviated but that vigorous cancer cells are unlikely to be killed by it.

On neutron ray treatment, the Society's verdict is more hopeful, although it indicates more time is needed to determine the cancer-curing value of this treatment. High speed neutron rays are not expected to give much better results in curing cancer than high voltage x-rays, but there is a possibility of capturing the slow neutron rays and putting them as well as the fast ones to work at destroying a cancer. A recent report of attempts to do this by injecting boric acid into the tumor or cancer, to capture the slow neutrons, makes it appear "probable that some method based on this principle will prove of practical value in treatment of cancer, with high speed neutrons."

X-rays themselves, already serving valiantly as cancer destroyers in some cases, may also be considered a machine age development. Radium, another of the Big Three that are curing cancer today, is a chemical element rather than a machine, but it can truly be called a machine age discovery. Oldest of the Big Three for cancer treatment is the surgeon's knife. Surgery was practiced in prehistoric times, but the modern surgeon's healing scalpel is a machine age product.

These machine age developments for cancer conquest are directed toward treatment of cancer patients. For prevention of cancer, scientists have turned to chemistry, genetics, and the study of races, skin color, sunlight and food. Much knowledge has been won, the Society's report indicates, but the twin puzzles of what causes cancer and how it can be prevented have not yet been completely solved. — *Science News Letter.*

Potassium Thiocyanate Lowers Blood Pressure

High blood pressure, which "kills more people in the United States today than any single disease factor with one or two exceptions," is no longer as hopeless as it has been believed to be, Dr. Paul F. Dickens, George Washington University medical professor, declared at the Post Graduate Clinic.

He based his statement on recent work with a new medicine for reducing high blood pressure which can be used to treat patients in their own homes and will not only keep the blood pressure down but keep the patients free of symptoms for several years to come. This medicine is potassium thiocyanate. Although the medicine has been used for several years, physicians are getting better results with it now because they have learned to base the size of the dose on frequent measurements of the amount of cyanate in the patient's blood.

Papaverine hydrochloride, another relatively new

drug, derived from opium, is giving good results in cases of disease of the blood vessels of the heart, brain, arms and legs. There is good hope, Dr. Dickens said, that if this drug is used early, patients with cerebral thrombosis, with paralysis on one side, can be saved from death and their paralysis overcome.

High blood pressure is the greatest killer except cancer and tuberculosis, Dr. Dickens believes, even though mortality records do not show many deaths directly attributed to high blood pressure. The reason, Dr. Dickens explained, is that the deaths are attributed to diseases of the heart, kidneys, thyroid gland, or apoplexy.

Those who, like Dr. Dickens, have spent years studying the problem of high blood pressure are chagrined at the medical profession for calling it a symptom, he declared.

"Anyone with high blood pressure has a race going on in his body between whether he will die of apoplexy, kidney disease or heart failure. The race is usually won by heart failure," Dr. Dickens said. — *Science News Letter.*

Synthetic Gland Extract Prevents Surgical Shock

Safer surgical operations and speedier recovery from them, especially for debilitated patients, seem promised by a new treatment for preventing dangerous shock during and after operations. The treatment, using a synthetic adrenal gland hormone, was developed by Dr. David Perla, of Montefiore Hospital, New York.

"Striking benefits" in 14 cases at this hospital are reported by Dr. Perla, who said that the treatment will shortly be adopted in two other New York City hospitals.

The patients treated at Montefiore were what would be considered poor surgical risks because serious chronic illnesses such as cancer and tuberculosis had weakened them so that they would have little strength to withstand an operation. Without the new treatment, patients of this type might have had to forego the chance of being helped by surgery because the shock of the operation might cause fatal prostration and collapse.

With the new treatment, patients are prepared for operation by being given quantities of salt solution and carefully prepared doses of desoxycorticosterone acetate. This chemical is the synthetic vital hormone of the adrenal glands. Early studies have shown that these glands play a significant role in the body's fight against intoxications, poisons, shock and infections. The adrenal cortical hormone, Dr. Perla explained, influences the transfer of water from tissues to cells and the level of salt in tissues and cells. Disturbance of this glandular balance, which frequently occurs in an exhausting operation, leads to collapse.

"In all instances the patients were strikingly benefitted," Dr. Perla said in this report of the new treatment. "There was no objective evidence of shock. The blood pressure was maintained or elevated. The temperature in general returned to normal within 24 to 48 hours. Post-operative exhaustion and toxemia were definitely lessened. Complications did not occur. Operative recovery seemed to the surgeons concerned to be more rapid than in their preceding surgical experience in our hospital. — *Science News Letter.*

Section on Physical Therapy Medical Society of the County of Kings

On Thursday, April 18, at 8:30 P.M., the Section on Physical Therapy of the Medical Society of the County of Kings will hold their regular monthly meeting, in the Dispensary Building Auditorium of the Beth Moses Hospital, Pulaski Street and Stuyvesant Avenue, Brooklyn. A Symposium on Paralysis has been arranged as follows:

1. Neurologic Consideration, *Abraham H. Rebbiner*, M.D., Director, Neurology, Kings County Hospital; Consultant, Neurology, St. Catherine's Hospital; Neurologist, Beth Moses Hospital; 2. Orthopedic Management, *Nathan R. Rachlin*, M.D., Orthopedic Pediatric Surgeon, Beth Moses Hospital; Assistant Orthopedic Pediatric Surgeon, Kings County Hospital; 3. Physical Therapy, *H. Tevel Zankel*, M.D., Assistant, Physical Therapy, Coney Island and Beth Moses Hospitals; Assistant, Physical Therapy, Polyclinic Hospital.

On Thursday, May 9th, at 8:30 P.M., this same society will present a Symposium on Fractures of the Extremities, in the Kings County Medical Building, 1313 Bedford Avenue, Brooklyn. The program is as follows:

1. Orthopedic Management of the Lower Extremity, *Morris T. Koven*, M.D., Associate Orthopedic Surgeon, Beth-EL and Jewish Hospitals; 2. Surgical Management — Upper Extremity, *Ottokar Tenopyr*, M.D., Surgeon, Kings County Hospital, Associate Surgeon, Caledon Hospital; 3. Physical Therapy, *Harold Neifeld*, M.D.

The medical profession is cordially invited to attend both meetings.

Samuel A. Warshaw, M.D., Secretary,
1373 Ocean Parkway, Brooklyn.

A Correction

In the article, "Effect of Natural Carbonated Baths on Rate and Amplitude of Pulse and Pressure," which appeared in the March, 1940 issue, the first two lines in Table 1 should have read:

Increase	1	1	12	12.0
Decrease	77	86	1—40	8.2

Cold Blood Can be Used Safely in Transfusions

Cold blood from blood banks may safely be used for transfusions without previous heating, Drs. Elmer L. DeGowin, John E. Harris and E. D. Plass, of the State University of Iowa College of Medicine, announce. (*Journal, American Medical Association*, March 9.)

"Economic pressure in the United States" and "military necessity in Europe" have stimulated interest in these banks of preserved blood for human transfusions, they point out.

The use of cold blood, at temperatures between 59 and 77 degrees Fahrenheit, without first warming

it to body temperature of 98 degrees Fahrenheit, saves time and money in transfusions and avoids the danger of getting the blood too warm during the preheating. Cold blood does not significantly lower the patient's temperature nor does it cause consistent change in blood pressure or other untoward clinical symptoms.

The effect of storage on the blood was also studied by the Iowa investigators. They make it a rule, as a result of their studies, to discard citrated blood after 10 days of storage, and to discard blood in a dextrose-citrate mixture after 30 days.

For military purposes, when preserved blood for transfusion must be transported considerable distances, the studies show that the dextrose-citrate mixture is the preservative of choice and that the blood should be kept in flasks containing no air. These two measures help to prevent damage to the red blood cells by shaking of the blood in transportation. Rubber stoppers, a great advantage over cotton plugs from the standpoint of facilitating transportation, are as good as the cotton plugs for preserving the blood. — *Science News Letter.*

Dramatic Success Reported With New Treatment of Burns

The dramatic recovery of a young girl from severe burns following the first trial of a new transfusion treatment daringly given in the face of impending death is reported by Drs. H. M. Trusler, H. L. Egbert and H. S. Williams, of Indianapolis. (*Journal, American Medical Association,* Dec. 16.)

Even though the girl was so gravely ill by the fourth day of treatment that "all who saw her were convinced she would die," the physicians did not lose faith in their new system of treating severe burns. Their courageous persistence was rewarded by their pretty young patient's complete recovery.

Transfusions of large amounts of blood and reduction in the amount of water and other fluids given the patient are the chief points of the new burn treatment. Heretofore physicians have tried to fight shock, first cause of death in extensive burns, by giving all the fluids the patient will take and urging him to take even more. This treatment, the Indianapolis physicians declare, may cause water intoxication severe enough to kill the patient.

An experience with this standard treatment in which the patient, a two-year-old baby girl, died led them to their new theory on burn treatment. Postmortem examination of the child's body showed "a tremendous waterlogging of all tissues." Changes in the child's blood, including a striking deficiency of salt, also suggested that large quantities of fluid were harmful in treating burn shock.

The Indianapolis physicians were in the midst of animal studies of their new theory of burn shock treatment when a 15-year-old girl was brought to the hospital an hour after she had been badly burned when her evening dress caught fire from a lighted match thrown on the ballroom floor. Daringly, the physicians used the new system of treatment.

Morphine, to relieve pain, removal of the charred remnants of her dress, and a one and one-half hour bath with salt water and green soap came first. About one pint of salt water with sugar was injected, and her drinking water, orange juice and the like were limited to about one quart a day. Meanwhile blood donors had been found and typed and eight hours after arrival at the hospital she was given the first transfusion of about one pint of blood with about one pint of salt water.

The young patient had a stormy illness. Her temperature was persistently high, and any manipulation caused chilling. She had altogether six large blood transfusions within four days, two of them consisting of blood plasma alone because tests showed an excess number of red cells in her blood. Because of her grave condition, the fifth transfusion was given "with considerable apprehension," the doctors report, and the sixth was given 24 hours later in spite of the fact that symptoms of reaction after the fifth one were growing worse. This was followed by a chill and rapid rise in temperature, and at this time the patient was not expected to live. She was placed in an oxygen tent and her condition slowly improved. Within one month she was able to go home and within two months her burns were completely healed and she was entirely well.

"We believe that a state of irreversible shock was prevented," Dr. Trusler and associates state, "and that her life was saved by the repeated intravenous administration of properly balanced fluids, the most important components of which were blood and blood plasma."

They also stress the value of oxygen and describe the treatment of the burned area. In this connection, however, they declare that "no local application can be expected to save life after a large burn. — *Science News Letter.*

Chemical Remedies Useful in Middle Ear Infections

The new chemical remedies, sulfanilamide and sulfapyridine, are valuable for treating about 40 per cent of the acute middle ear infections likely otherwise to end in mastoid trouble, Drs. L. Dell Henry and Hugh A. Kuhn, of Hammond, Ind., found in their experience with 268 patients, ranging from three months to 63 years of age.

Reporting these results to the American Laryngological, Rhinological and Otological Society meeting in Columbia, S. C., Dr. Kuhn warned fellow physicians not to use these chemical remedies without first making tests to learn what kind of germs are causing the ear trouble in each case. Nearly half the patients, he and Dr. Henry found from such tests, had ear infections of a type that could not be helped by either sulfanilamide or sulfapyridine. Since the chemicals are not without danger, Dr. Kuhn said, they should not be used indiscriminately.

Out of the whole group of cases studied, 6.6 per cent developed mastoiditis. The necessity of early investigation and treatment of otitis media (middle ear trouble) is shown by the fact that the patients who had early attention with early surgical opening

of the ear drum had a risk of two-thirds less than the ones in whom the condition was allowed to go on until the drum ruptured spontaneously. — *Science News Letter.*

Influenza Increases, Hint of Coming Epidemic

Hint of a coming epidemic of influenza appears in reports to the U. S. Public Health Service, although incomplete reports for the last week in December, latest available, showed a drop in the number of cases.

The number of cases has been steadily increasing ever since October and during December ran from 1,000 to 5,000 cases higher per week than during the five-year median for the same period. For the week ending Dec. 30 there were 4,836 cases reported, but two states, among them South Carolina which has had the highest figures, have not yet reported. The week of Dec. 16, there were 6,455 cases reported throughout the nation, 2,353 of them in South Carolina. The number fell during the week of Dec. 23, and dropped still lower during the week of Dec. 30, but incomplete reporting during the holidays may account for this drop in reported cases.

For the week ending Dec. 30, public health statisticians expected an increase of 25 per cent over the previous week. Unless South Carolina reports a new high figure, this expectation will not be fulfilled. While this seems encouraging, the "steady but not alarming" increase during the winter suggests that an epidemic may nevertheless be on the way.

Two states besides South Carolina have had more than their share of influenza, the reports show. Alabama reported 1,298 cases for the week ending Dec. 30, and Utah reported 964. These figures are considered high in relation to the small population of the states. — *Science News Letter.*

Find New Pneumonia Germ and Make Serum for It

Discovery of a new kind of pneumonia germ, responsible for more illness than some of the other types, and development of a serum for detecting its presence and treating its victims are announced by the New York City Department of Health and Lederle Laboratories, Inc.

The germ is called pneumococcus Type 33. Hitherto scientists have recognized 32 types of pneumonia germs, following the classification by the late Dr. Georgia M. Cooper, N. Y. C. Department of Health.

The newest one, Type 33, was isolated by Dr. Jesse G. M. Bullowa, of Harlem Hospital's pneumonia service, and was first called the Wilder strain. Numerous specialists during the pneumonia season of 1937-1938 reported that they were encountering pneumonia in their patients which, though the germs seemed to be related to Type 9 pneumococci, did not respond to treatment with Type 9 pneumonia serum treatment. The germs, isolated by Dr. Bullowa, and by other investigators in the United States and abroad, were studied in the New York City health department laboratories where they were designated as a new type of pneumonia germ.

Serum for diagnosis and treatment of this type of pneumonia infection has been prepared by Lederle Laboratories, and reports since it has been in use show that it is a more frequent causative agent of pneumonia than some of the established higher types. — *Science News Letter.*

Huge Hole in Cuba Supplies Much of Nation's Manganese

During the Spanish-American War one of Teddy Roosevelt's Rough Riders kicked a piece of ore in Cuba and began a chain of events which today sees Cuba supplying a large share of the American steel industry's needs of strategic manganese.

The whole story of the Cuban manganese industry and its role in the economic fortification of the great American steel industry was told at the meeting in New York of the American Institute of Mining and Metallurgical Engineers by F. S. Norcross, Jr., engineer and president of the Cuban Mining Company.

Out of the kick of the Rough Rider's foot have come great holes in Cuba — the largest a half mile long and 1,000 feet wide — which are the strip mine pits where manganese ore is dug out of the earth.

Averaging from 17 per cent to 18 per cent metallic manganese in content, the Cuban ores are refined and concentrated to bring them up to ferromanganese grade for use in steel making which requires 48 per cent manganese or better.

During the years from 1936 through 1938 the steel plants of the U. S. required about 736,000 tons annually of high grade ore from foreign sources. The 1938 Cuban production was 131,000 tons. — *Science News Letter.*

Man Is Longest-Lived Mammal, Studies Show

Longest-lived among mammals is man himself, it is indicated by Maj. Stanley S. Flower, British zoologist who has collected data on this much-discussed subject for many years. Centenarians are found with increasing frequency nowadays, Major Flower states in the current issue of *Fauna*, and he has one apparently authentic record of a human being reaching the age of 114 years.

The elephant, which was long supposed to top man for age, is an exceptionally long-lived animal even though its oldest veterans fall a couple of years short of the half-century mark. Other long-lived big animals in Major Flower's records are a rhinoceros that lived to be more than 40 and a hippopotamus that reached the age of 41 years and 6 months.

Size, however, has no necessary connection with age: figures for lion, tiger and domestic cat are 25, 19 and 20 years, respectively. Record age for a captive gorilla is 13 years, for an animal still

living at the Philadelphia Zoo, while a little Cebus monkey nearly doubled that figure, dying at 25.

Ages of 500 years and more, claimed for turtles and tortoises have proved to be exaggerations. However, there are apparently authentic records of tortoises reaching ages of 125 and 152 years, and a somewhat less dependable figure of 123 years for a common box turtle. Outside the turtle family, reptilian ages are not extraordinary. — *Science News Letter.*

Abscessed Teeth Treated With Hot Sulfanilamide

Success in the treatment of abscessed teeth with the chemical remedy, sulfanilamide, was reported by Dr. Fred R. Adams, of New York, at the Greater Philadelphia Dental Meeting in Philadelphia.

One injection directly into the abscess of a hot sulfanilamide solution killed all the trouble-making germs in every case but two, Dr. Adams reported. One case required two such treatments and another, three. Some of the abscesses that were cleaned up in one treatment had persisted for 10 years. X-ray pictures of these cases showed that after a few months new bone had grown to fill the area formerly occupied by the abscess.

Heating the sulfanilamide solution for treatment is important, Dr. Adams emphasized. A stronger concentration of the drug can be obtained in hot water and the heat re-enforces the chemical's action on the germs, he explained.

This method of using a hot sulfanilamide solution for irrigation should, in Dr. Adams' opinion, be useful in treating infections in other parts of the body, such as sinus infections and the bone diseases osteomyelitis and osteitis and in cellulitis involving bone. — *Science News Letter.*

Dr. L. Leo Doane 1857-1940

It is with deep regret that we announce the passing of one of the oldest, staunchest and most beloved members of the Congress. Dr. L. Leo Doane was born in 1857. He was graduated from the College of Physicians and Surgeons in 1886 and licensed in the same year. He became a member of the American Academy of Ophthalmology and Oto-Laryngology in 1935. Dr. Doane, formerly of Butler, Pennsylvania, died in Highland Park, Illinois, April 13, 1940. The Congress extends its sympathy to the bereaved members of his family.

TECHNICIAN EXAMINATIONS

Written, oral, and practical examinations for registered technicians will be held the latter part of June in Chicago, and New York City. The exact date will be announced. All who expect to be candidates should send in their applications as early as possible. Address all communications pertaining to the American Registry of Physical Therapy Technicians, to 30 North Michigan Avenue, Chicago.

BOOK REVIEWS

MASSAGE AND REMEDIAL EXERCISES IN MEDICAL AND SURGICAL CONDITIONS. By *Noël M. Tidy*, Member of Chartered Society of Massage and Medical Gymnastics. Fourth Edition. Cloth. Pp. 458 with 182 illustrations. Price, $5.25. Baltimore: A William Wood Book, The Williams & Wilkins Company, 1939.

The latest edition (4th) of Tidy's book is essentially the same in format and descriptive style as its predecessor. Few alterations have been introduced, the most radical being a new but short section on myositis ossificans and the effects of gas poisonings. The latter exposition no doubt will be regarded as timely as well as pertinent, especially because it promises to illuminate a problem of greatest importance connected with the hazards of modern warfare. Unfortunately, this discussion is rather disappointing, because it reviews the treatment of gas poisoning in such brief and somewhat hesitant manner that no reader will obtain more than a hint of its imminent importance and will have to resort to more informative sources for detailed guidance. In this objective the author has missed her greatest opportunity, for no more worthy and practical service could have been rendered contemporary medicine than an exhaustive review on any promising treatment related to this problem, especially in the view of the mounting number of convalescent combatants anticipated in the near future from gas poisoning. But even despite this neglect, it must be pointed out that this edition embodies many valuable sections of an informative nature. No matter to where one turns the page one encounters suggestions often as practical as they are neglected by the average physician. An example in point is the description and recommendation of Bier's passive hyperemia in cases of non-union, the treatment of fractures in the specific sense of mobilization, massage and remedial exercises, and the like. The book touches on so many practical aspects of physical procedures that it is recommended to every physician and masseuse interested in massage and remedial exercises for medical and surgical conditions.

ASTHMA. By *Frank Coke*, F.R.C.S. With collaboration of *Harry Coke*, M.F.C.S., L.R.C.P., Honorary Physician, Charterhouse Rheumatism Clinic. Second edition. Cloth. Price, $4.00. Pp. 266, with 3 illustrations. Baltimore: The Williams & Wilkins Company, 1939.

This second edition, published after a lapse of sixteen years, brings up to date much of the recent work on asthma. The author divides asthma into three groups. Type I is due to allergy or proteinhypersensitivity and is characterized by positive family history, skin tests and passive transfer reactions; excellent results are usually obtained by removal of the cause of attacks, e.g. feathers, pollen or certain foods; desensitization is of great assistance where these substances or foods cannot be removed. Type II is the infective group; it occurs later in life, has negative skin tests and negative passive transfer; the author claims great success with small doses of potent polyvalent autogenous vaccines. Foci of infection are also cared for. Type III includes those previously allergic cases who have become infected. Many of these patients are aspirin-sensitive; autogenous vaccines are valuable. The sedimentation rate is stressed; it is decreased in Type I, increased in Type II and about normal in Type III. The author believes asthma is due to broncho-spasm due to a toxin-histamin link; most American investigators state that the obstruction is due to edema rather than spasm. The book is small and is therefore necessarily very brief on many points, e.g. differential diagnosis, complications and the usual technic of hyposensitization. The use of the differential sedimentation test and of autogenous vaccines is dealt with at length; it is to be hoped that American investigators will be able to duplicate the excellent results obtained by the author in asthma caused by or complicated by infection.

DIATHERMY: SHORT WAVE THERAPY, INDUCTOTHERMY, EPITHERMY. By *William Beaumont*, M.R.C.S. (Eng.) L.R.C.P. (Lond.). Physician-in-Charge, Physiotherapy Department, Westminster Hospital, etc. Cloth. Pp. 303 with 106 illustrations. Price, 10/6 net. London: H. K. Lewis & Co., Ltd., 1939.

For years the consciousness of the medical profession has been stimulated with reference to the increasing value of diathermotherapy by men whose fame rests on contributions in this field. From Lewis Jones and Turrell to Cumberbatch in England, are found a representative group of pioneers who have rendered outstanding service to this domain of physical therapy, and by their labors have raised the orientation of the profession to a level that assured acceptance of clinical diathermy on a par with that of other scientific procedures. The generous dedication of this book to the memory of Cumberbatch is a thoughtful and no doubt sincere gesture on the part of Beaumont. The conviction, however, persists that a work on a subject with which the fame of Cumberbatch's name is so intimately associated should be one that attempts to reach the heights if not a starting point where the labors of that inspiring teacher ceased. Therefore, one is rather disappointed in the presentation because it manifests neither the scholarship and clarity of the recent edition of Cumberbatch's work on diathermy, nor the rich personal experience that qualified his work as an international contribution. It is difficult to escape the impression that the author struggled with a topic that already enjoyed authoritative exposition in his country and in ours because

of equally representative contributions by men of highest experience. The weakness of Beaumont's book lies in the direction of omission, commission and insufficient experience in determining and interpreting essentials as well as providing original facts as a *raison d'être* for his work. The reason for it given by him — "the student preparing for the examination of the Chartered Society, and the general practitioner who is interested in diathermy and especially short wave therapy" — is so superficial as to fall flat on even cursory examination. Indeed, any practitioner worthy of the dignity of his calling would demand his information from sources that contributed more than a revision of a limited amount of facts culled from other writers. The book may be easy reading for technicians and borderline practitioners, but cannot appeal to men whose training and scientific knowledge is of the level of graduates from modern schools of medicine. What has been written by the author on conventional diathermy is elementary and superficial, and his opinion on short wave diathermy can only be characterized as trivial. In a few instances where authorities have been quoted, typographic errors or unfamiliarity with proper spelling are evident. All in all, this book adds little to the literature on diathermy.

CANCER OF THE LARYNX. By *Chevalier Jackson*, M.D., Sc.D., LL.D., F.A.C.S., Honorary Professor of Broncho-Esophagology and Consultant in Broncho-Esophalogic Research, Temple University Medical School, Philadelphia, and *Chevalier L. Jackson*, A.B., M.D., M.Sc. (Med.), F.A.C.S., Professor of Broncho-Esophagology, Temple University Medical School, Philadelphia. Cloth. Pp. 309, with 239 illustrations. Price, $8.00. Philadelphia and London: W. B. Saunders Company, 1939.

The names of Chevalier Jackson, the father and master laryngologist, and of his son, represent such great authority in their special field that anything they contribute is certain to be highly informative. Other eminent specialists have tried to give the medical world the benefit of their experiences, but it is not very often that one finds combined in one individual great clinical skill and judgment and the ability to lucidly present them in the printed word. In the present monograph the authors appear also as competent teachers, so that even general surgeons and radiologists will be able to translate the printed word in terms of the actual clinic. As a complement to the clear diction there are provided no less than 189 ordinary and 50 colored illustrations of natural reproductions of conditions seen by laryngoscopy, which afford an excellent visualization of the special equipment for and manner of carrying out the various operative and radiotherapeutic procedures and—most important of all—the means to facilitate differential diagnostics.

While the book is strictly specialistic, the diction is virtually colloquial, much like an interested teacher trying to be helpful by cautioning against pitfalls and by stimulating the less experienced to be exact in every detail, especially with reference to meeting and overcoming accidents and complications during major operations.

In the very preface the authors present an excellent description of what most students seek in the literature for their clinical needs, and explain the arrangement of materials in that light. This must be accepted as the reason for dividing the book into three parts, differing from the custom of presenting the history of a subject as a sort of introduction and following this with anatomy, pathology, diagnosis and therapy. In this monograph the first part (13 chapters) takes up such problems as early diagnosis, selection of therapeutic procedures especially laryngofissure, laryngectomy, prognosis, articulate speech after removal of the larynx, lateral pharyngotomy, radiotherapy and palliative measures. The second part (11 chapters) is devoted to symptomatology, pathology, borderline tumors, precancerous lesions, biopsy, etiology and prophylaxis in the order here recounted. The last part (7 chapters) is a chronologic and critical account of the history of the various subjects treated in the preceding parts. This historic review of the concerned problems in laryngology is representative of the best in scholarship, but is marred in the authors' too evident prejudice against the great surgeon von Bergmann with reference to his part in the illness of Crown Prince Friedrich and their superlative adulation of the British laryngologist Morrell McKenzie. That there was bitter rivalry and political intrigues between the partisans is not denied, but calling von Bergmann an arrogant meddler when in fact he was kindness personified especially to American colleagues, is not helpful. Nor is an allusion to Virchow as a politician going to detract from his greatness as the father of cellular pathology, even though he did report the Crown Prince's growth as benign. Historians should be impartial and weigh all facts.

It is also noted that the authors have failed to discuss either electrotomy or electrocoagulation in the operative management of laryngeal cancer, although they admit the difficulty of controlling hemorrhage in depth. The standard set by Harvey Cushing in employing the high frequency current in procedures involving the removal of tumors deep in the brain applies with equal force to similar situations in other deeply situated organs or viscera. While the authors gave their own procedures and stated that surgeons have their own modifications, the subject of electrosurgery merited some place in their comprehensive monograph. These criticisms are offered with due regard for the right of any author to take a personal standpoint, because the interests of the readers cannot always be ignored. But apart from all this the authors are to be congratulated on this achievement in literature which adds luster to American laryngology.

INTERNATIONAL ABSTRACTS

Problems of Short Wave Therapy (Meeting of the Berlin Roentgen Society). B. Rajewski and E. Schliephake.

Foreign Correspondence J. A. M. A. **113**:1823 (Nov. 11) 1939.

Rajewski, of Frankfort-on-the-Main, and Schliephake, of Giessen, discussed short wave therapy. Long wave diathermy, they said, had disappeared almost altogether. The generally used wave length of 3 meters did not yet conform to the best conditions for the "selectivity factor;" 1 meter was more favorable. Also the problem of dosage by means of the method of Mittelmann, might soon be sufficiently clarified to be adopted. In the biology of high frequency currents attention should be called to the fact that the presence of "specific effects" is not sufficiently proved. In fact, much was still doubtful in this field. The 1 meter wave seemed to possess a superior penetration but was accompanied, as Schliephake pointed out, by certain dangers. Therefore, only specially trained and experienced physicians should employ it.

Disinfection by Radiation. George F. Dick.

Modern Hospital **53**:53 (Nov.) 1939.

The preparation of hospital rooms for the admission of new patients, particularly those rooms that have been occupied by patients with contagious diseases has long been a problem. The danger of transmission of infection by air was pointed out by Flugge in 1897 and has recently been emphasized by Wells. The presence of hemolytic streptococci in the air of rooms occupied by patients infected with such organisms has been demonstrated by Cruickshank and Godber. The author has on many occasions been able to grow hemolytic streptococci from the air of rooms occupied by scarlet fever patients.

In order to ascertain the efficacy of ultraviolet irradiation, three groups of experiments have been carried out in the contagious division of Billings Hospital in Chicago. In all experiments, cultures were taken both before and after irradiation with a special type of ultraviolet quartz lamp that gave 1200 microwatts per square centimeter at a distance of 6 inches. All doors and windows in the room were closed. A 14 inch electric fan, which had been wiped thoroughly with a clean cloth wrung out of tap water, was placed at one side of the room facing the bed and run at full speed, oscillating, for ten minutes in order to circulate the air of the room thoroughly. At the end of this time the oscillating mechanism was stopped but the fan was continued at full speed. Two petri dishes containing blood agar were placed on a rack with the surfaces nearly vertical, exactly 2 feet from the fan, and the covers were then removed. The culture medium was exposed to the direct air current from the fan for either fifteen or twenty minutes. The lamp, placed in the center of the room, was then turned on and the oscillating mechanism of the fan again started. Both lamp and fan were kept on for an hour or half hour, according to the experiment. At the end of this time the lamp was turned off, the oscillating mechanism of the fan was stopped and two blood agar plates were again prepared and exposed exactly as were the first two.

In the first group of experiments, this procedure was carried out in 21 rooms immediately after the patient left the room. The period of irradiation was one hour and the plates were exposed for twenty minutes. In the second group of 30 experiments, the procedure was the same but the period of irradiation was shortened to half an hour and the plates were exposed for fifteen minutes. In the third group of seven experiments, the room had been prepared for a new patient in the usual fashion before the experiments were carried out. Floors were scrubbed, walls were washed to a height of 6 feet, fresh linen was put on the beds and the rooms were aired. The time of irradiation was half an hour and the plates were exposed for fifteen minutes.

The first half-hour of irradiation would appear to be sufficient to bring about the desired results. It is of interest that in all except seven experiments, the bacteria found on the plates were staphylococcus albus and saprophytic bacteria. In two of these experiments, pneumococci were found before radiation, and none was found after radiation. In the other five experiments, in which hemolytic streptococci or streptococcus viridans were found, in three cases none was found after irradiation.

Induced Pyrexia (Transaction, Medical Society of London). E. J. Nattrass.

The Lancet **26**:1317 (Dec. 23) 1939.

Malarial and artificial pyrexia were compared in the treatment of general paralysis of the insane, and Nattrass declared that whatever method of producing fever was used the fever alone had any importance, though it might not in all cases act by the same mechanism. Theoretically the method which most consistently provided a sustained fever should be the most successful, and, judged by this test, physical were superior to chemical or bacteriological methods. The most outstanding point of superiority for physical methods were their low mortality, and during the last four years he had treated 213 cases without a death. Unlike malaria, electrical treatment did not make the patient ill, and caused relatively little discomfort. Complications, such as anaemia and jaundice, did not occur, and the fever could

precisely be controlled. Fever should be given until the maximum clinical response has been obtained. On an average Dr. Nattrass gave four to six treatments at 106 F., each lasting eight hours. Thermotherapy should be supplemented by specific treatment, especially with tryparsamide and bismuth. These, however, should not be injected during the fever. Fever caused a fall in the cell-count of the cerebro-spinal fluid, but any change in the Wassermann and Lange reactions was slow. For sedation he had used paraldehyde and morphine, but during the later stages of induction remarkably little sedative was needed.

Electrically Induced Convulsions in Treatment of Mental Disorders. Wm. H. Shepley, and J. S. McGregor.

Brit. M. J. **2**:1269 (Dec. 30) 1939.

It is agreed by most workers that, despite certain disadvantages, shock treatment in mental diseases is justified by results. A new method of inducing convulsions by means of electric current has recently been advocated. It originated at Rome, being developed by Cerletti and Bini. The introduction of this method may appear to require some justification since it necessitates the use of considerable voltage. However, reasonable safety is indicated by the fact that a considerable number of such convulsions have been induced without fatality in patients treated at the Rome clinic. In his experimental work, Cerletti has examined histologically the cerebral cortices of dogs after the application of much higher voltages than necessary to induce a fit and following the induction of multiple fits. These examinations showed an absence of such neuro-pathological changes as had been found following insulin coma and in a lesser degree following cardiazol convulsions in experimental dogs (for example, hemorrhages, disappearance of Nissl's granules, and other cell changes of a more chronic nature). The authors describe the technical aspects and the apparatus employed by them for electric therapy. They use a modification of the Bini patent. This has 3 advantages over the Italian apparatus: (1) an electrical time switch; (2) a ballistic method of measuring the milliampere-seconds; (3) the arrangement for compensation of fluctuation in the mains. The voltage determination is largely a matter of experience. The figures given by the Italian workers, 80-115 volts, appear to be rather low. The lowest voltage with which the authors obtained a major fit was 90, giving 600 ma. through the head. Measurement of head resistance affords some indication but it bears little relation to the actual resistance on the "shock" circuit. The voltage used by them varies between 90 and 145, with a time setting of 0.1 to 0.2 of a second. The results of the passage of current may be described as the major fit and the abortive fit, in both of which there is immediate loss of consciousness. The major fit is a typical epileptic fit, lasting 50 seconds on an average. The patient is restored to consciousness and is able to talk somewhat drowsily within a few minutes. Slight restlessness may precede return of consciousness but the authors have never observed any psychomotor excitement such as is so commonly met with after cardiazol. In the abortive fit, there is usually an initial generalized myotonic flexion of the body. The face becomes flushed, pulse accelerated, and blood pressure rises about 10 mm. Hg. respiration may be shallow, the face assumes a dusky hue, and pupils may be dilated or fixed, or, more often, react briskly. The effect of an abortive attack may be limited to loss of consciousness and flushing of the face. Within 2 minutes the electrodes may be reapplied and another attempt made to produce the major fit. In both the major and abortive fits, there is a retrograde amnesia for a period of about 2 minutes before the passage of the current. The only complaint made by some patients is of slight headache.

The advantage of this method of inducing convulsions by electricity lies chiefly in the instantaneous loss of consciousness, so that fear or apprehension are precluded. The authors state that therapeutic results, they have reason to believe, will compare favorably with those of other methods, and may even be better because fear and dread are eliminated. Another advantage is the absence of recovery symptoms such as psychomotor excitement and vomiting.

New Conceptions Concerning Electroencephalography in Epileptics. Ph. Pagniez.

Presse méd. **47**:1616 (Dec. 16) 1939.

Studies pursued in different countries for about 4 years have produced interesting results in the study of epilepsy. Registration of the cortical activity of epileptics has shown in these patients very special particularities of 2 types. There is, on the one hand, a permanent slowing up of the alpha waves, seen especially in grand mal; on the other, intermittent modification of the tracings which precede and accompany the paroxysms. These modifications differ, according to whether they accompany the convulsion or the manifestations of petit mal. They are entirely characteristic.

One of the most curious points revealed by these EEG studies in epileptics is that in these patients the signs of abnormal electrical activity may appear also without any visible epileptic manifestation and without any subjective perception on the part of the patient. These "electric crises" are especially frequent in certain subjects: are an almost constant phenomenon in epileptics with frequent episodes of petit mal, and control studies have shown that this very special alteration of the curve is not observed in normal subjects, nor even in patients with other nervous disorders.

Two recent publications give unexpected and very interesting results on this point of the question. H. Löwenbach, having had occasion to observe 2 children, a boy of 15 and his sister of 12

years of age, both epileptics with grand and petit mal, and having established in the 2 children a typically epileptic EEG, examined the brother of these children, aged 9 years, and observed that this child, who had never manifested any epileptic symptom, had a very abnormal EEG, analogous to that recorded in certain epileptics subjected to efficacious treatment. Löwenbach then examined the near relatives of 11 epileptics, or 37 individuals. In these 37, 17 furnished an abnormal EEG, which could often be exaggerated by a hyperpnea test of several minutes, and 4 presented a typical epileptic tracing. Lennox, Gibbs and Gibbs, in important studies on the EEG of epileptics, made similar observations. They considered the EEG disturbance in epileptics as a paroxysmal cerebral dysrhythmia. These authors studied the EEG in the family of 76 epileptics registering cortical electricity by 6 electrodes applied simultaneously. The number of subjects tested was 138, of which 100 were the parents of epileptics and 20 their children and collateral relatives. In this material, 54 per cent presented a distinct cerebral dysrhythmia of the EEG. When the 2 parents of a patient were examined, the figure rose to 60 per cent. By way of control, 50 individuals were chosen in families having no history of epilepsy. The proportion of dysrhythmia furnished by these subjects was 6 per cent.

These facts show first that the presence on the tracing of "electrical crises" of dysrhythmia, independent of all clinical manifestations, is not absolutely proper to epileptics, since it appears in 6 per cent of the apparently normal controls. They indicate, however, that these anomalies are infinitely more frequently in the families of epileptics. As Lennox and his collaborators insist, this shows that certain subjects have a probably congenital predisposition to the development of epilepsy, which is conditioned by electrical modifications, at least in part. It is perhaps too early to interpret these results as peremptory arguments for the hereditary character of epilepsy.

The Effect of Warm and of Cold Naso-Pharyngeal Irrigation of Cervical Lymph Flow. Jane D. McCarrell.

Am. J. Physiol. **128**:349 (Jan. 1) 1940.

Cervical lymph flow was measured quantitatively in dogs during 20 or 30-minute periods of nasopharyngeal irrigation with isotonic saline at temperatures ranging from 5 C. to 55 C. Passive motion of the head of the animal insured a constant lymph flow without the use of massage. Critical temperatures, with respect to lymph flow and protein content, were found to correspond closely to those reported for general vascular changes influencing capillary filtration.

Continuous irrigation with isotonic saline at temperatures above 5 C. and below 45 C. caused no marked variation in lymph flow or in its protein content. At 45 C. the lymph flow increased with no change in the protein percentage. This augmented flow continued only during the period of heat application and was the result of a rise in the rate of capillary filtration. At 50 C. and above, irreversible changes in capillary permeability occurred. The lymph flow became profuse, was highly proteinized, and did not return to normal with reduction of the temperature. Irrigation at 5 C. produced an augmented lymph flow which, depending upon the absence or presence of capillary damage, was either temporary or more prolonged.

Blood Serum Changes in the Dog During Recovery from Exercise on the Treadmill. Minerva Morse, and F. W. Schultz.

Am. J. Physiol. **128**:417 (Feb. 1) 1940.

The changes in the electrolyte pattern of the blood serum during recovery from muscular exercise on an inclined treadmill have been studied in five dogs. The experiments may be grouped into three series according to the type of exercise: (a) 2 minutes of very rapid running; (b) 25 to 37 minutes of vigorous running to the point of fatigue, and (c) 55 to 72 minutes of less vigorous running to the point of fatigue.

The results may be summarized as follows. Serum lactate often continues to rise and bicarbonate to fall for some minutes after exercise, but the fall in bicarbonate after exercise exceeds the rise in lactate. Although similar high lactate concentrations are reached after both the 2 minute and the 25 to 37 minute vigorous run, the return to the initial concentration is more rapid after the shorter run. Inorganic phosphate and potassium fall markedly for some time after exercise but usually return to the initial level within 2 hours. Serum chloride often continues to rise for at least 10 minutes after exercise and remains elevated above the initial level two hours later, but the concentration of serum protein, with few exceptions, falls rapidly below the initial level after exercise and fails to return.

Evaluation of Short - Wave Diathermy. Richard Kovács.

Brit. J. Phys. Med. **3**:5 (Jan.) 1940.

In the light of present knowledge, there appear to be no specific conditions in which short-wave diathermy is definitely preferable to long-wave diathermy because of different clinical effects. Because of convenience of application its methods may be preferable for certain locations or conditions.

The advantages of localizing treatment by direct contact plates and the avoidance of spacing has been corroborated by the author not only by using the older type of long-wave spark-gap apparatus, but also by employing a recent development in short-wave diathermy apparatus. This consists of using a tube apparatus with an additional patient's circuit, in which suitable extra condensers and coupling allow energy transfer through contact electrodes. The author now gives preference to this method in treating most of the bursae and joints as well as cavities. While it necessitates the return to carefully applied con-

tact metal electrodes, it offers three other very definite practical advantages; (1) it enables the insertion of a milliampere meter in the patient's circuit for direct reading of the output of the apparatus and a fairly accurate estimate of dosage; (2) it enables handling of the treatment cables without drawing energy from them, as they no longer form part of the treatment circuit; it also obviates the danger of their overheating by crossing over each other or touching grounded metal; and finally, (3) it cuts down radio interference to a minimum because there is no superfluous scattering of energy into space.

An Ionic Transmission Method for Testing with Allergens. L. O. Dutton.

J. Allergy **11**:130 (Jan.) 1940.

A number of preliminary experiments were made with various allergenic extracts. The apparatus consisted of a simple battery of 15 volts with a voltage meter, milliammeter, and a rheostat in the positive lead. Eight or ten allergens were tested at each sitting. It was found by this method that positive pollen tests were readily obtanied. Tests for animal epidermals and house dust were less successful, and positive tests for foods were successful only on individuals who showed marked skin reactions by other methods. After investigating the effect of the area of the electrode, Dutton found that much more intense reactions could be obtained with all classes of extracts when the area of the electrode was decreased to about 0.5 to 1.0 sq. cm. This decreased the practical effectiveness of any apparatus in regard to the number of tests it was possible to do at one time. At present he has constructed an apparatus having 10 positive leads by using two B batteries and a milliammeter and rheostat in each positive lead. He is thus able to deliver simultaneously comparable electric densities to 10 small areas. This has been found to be quite effective in testing with pollens, dusts, and foods.

In connection with the technic, there are many problems yet to be solved. The most important probably centers around the type of extract to be used. As has been pointed out, the pH, the presence of electrolytes, and the concentration of the substances in solution, all have a highly important bearing on the production of sufficient mobility of the substance to insure that adequate amounts enter the skin. The author carried out a number of experiments paralleling tests with the conventional glycerosaline extract with tests with simple aqueous extracts that have no added electrolytes or glycerin. It is unmistakable that with the aqueous extracts he obtained considerably more penetration as evidenced by the size of the resulting wheal. Furthermore, in many instances, he was able to reduce the time of exposure from ten minutes to two or three minutes and yet obtain comparable wheal production. He has not yet been able to do comparative tests with extracts of different pH. It is most likely that when these are done, some considerable variation will be found.

Physical Measures in Some Common Painful Gynecologic Conditions. Madge C. L. McGuinness.

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Lumbar backache is usually due to fatigue and strain. It is common during pregnancy when there is a tendency to maintain balance by stretching backward to overcome abdominal weight. Weak musculature, due to lack of exercise during this period causes a marked enteroptosis giving rise to sacral pain which passes below the iliac crest toward the bladder. Obese patients are especially uncomfortable.

Lumbar backache in the nonpregnant may be due to faulty posture, sitting or standing, especially if at long hours. Improper posture and spinal curve defects cause backache that the patient insists is pelvic or sacroiliac. Improper heels that throw the body out of alignment and flat feet may be at fault. When one limb seems shorter than the other, a lift in the heel often relieves the pain. Proper body mechanics, rest, corrective exercise, massage, local diathermy, phototherapy, static wave will help weak muscles of spine and feet. Proper footwear is most essential.

Sacroiliac backache is especially common in the asthenic type. Strain, fatigue, overwork, falls, poor body mechanics, osteoarthritis, abscess or neoplasms are responsible. It is worse after a night's sleep, long confinement on the back as in parturition, operations or even on treatment tables. Organic lesions as neoplasms or abscess must be ruled out. General body building and improvement of weak musculature call for indicated therapy. Backache due to other causes must be sought in the thoracic and abdominal viscera and in intoxications of the general system. Exercises, carefuly graded, are especially required and improve muscle tone in a few weeks. Massage is esseptial at first in those asthenic patients who cannot exercise without marked fatigue. All exercises should be begun lying down so that there will be not too great a tax on the circulatory or other systems. Hydrotherapy, local diathermy, both long and short wave, and the static wave are of great value by improving the nutrition.